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Published every Friday by
The Machinery Publishing Co., Ltd.

Price 1/3

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NEW YORK: 93, Worth Street

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SUBSCRIPTIONS:—Inland and overseas, 52 shillings per annum, post free. Cheques and Money Orders should be made payable to the Machinery Publishing Co., Ltd.

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MACHINERY

A JOURNAL OF METAL-WORKING PRACTICE AND MACHINE TOOLS

Vol. 92, No. 2363 — February 28, 1958

COPIES PRINTED.................................11,500 per week

CERTIFIED DISTRIBUTION.....................11,376 per week

CERTIFIED PAID DISTRIBUTION............10,566 per week

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Abstracts of Principal Articles

The Production of Components for Lambretta Motor Scooters............ P. 468

This article—the fourth of a series—is concerned with the final operations on the two portions of the crankshaft for the Lambretta 150-c.c. engine, including the grinding of the oil seal surfaces on which the shaft is located after assembly, and of the bores into which the shouldered crank-pin is pressed. Assembly is carried out on a hydraulic press, with a special fixture in which the two parts of the crankshaft are located and clamped, one above the other. Operations on the sub-assembly, which now incorporates the connecting rod on its needle roller bearing, start with re-cutting the centres in the shaft ends, after which two keyways are cut in a special machine, one for the tab of a locking washer and the other for the fan and dynamo assembly drive. After removal of excess metal from the crank-pin ends, the shafts diameters are finish-ground on twin machines, fitted with form-dressing attachments for multi-diameter grinding. A special Innocenti-built machine is then employed for a thread-milling operation, before the driving splines at one end of the shaft are finish ground. At the ends of the shaft, threads of opposite hand are rolled on an Italian machine of conventional design. Finally, the oil seal surfaces are super-finished on an Innocenti lathe fitted with an air-operated attachment. (MACHINERY, 92—28/2/58.)

Mechanical Handling Equipment for Motor Car Body Stampings .... P. 478

In the new stamping plant of the Chrysler Corporation, U.S.A., there are 28 main press lines, with a total of 260 presses, and mechanical handling is employed extensively. Large sheets for roof panels, for example, are delivered to a live-roller table on pallets, which are moved to the operator's station, as required, and the sheets are then transferred to the loader for the first press. The pressing, which is drawn upside down, is removed by an Iron Hand at the rear. It is deposited on a flip-over device whereby it is inverted, and is then carried into the second press by a shuttle loader. At the end of the line the panels are pulled on to a belt conveyor by side-arm extractors. Other equipment provides for inverting quarter-panel pressings and then turning them through 90 deg., and for extracting trimmed panels by means of vacuum cups. (MACHINERY, 92—28/2/58.)

Methods and Equipment for Checking External Tapers .... P. 483

Tapers are widely employed in industry for such purposes as locating and driving, and if they are to function efficiently must be accurately made. Various methods are available for checking the angles of tapers, including the use of slip-gauges and rollers, or the application of Micyl blocks which have been developed specially for this purpose. Taper rings and equipment based on the measurement of the sine of the taper angle may also be employed effectively in some instances. Special equipment has been developed whereby the tapered workpiece is viewed above a source of diffused light, while it is held in contact with accurately positioned straight-edges. (MACHINERY, 92—28/2/58.)

The Necchi Die Casting Foundry ... P. 499

Necchi sewing machines, which are now made at the rate of more than 1,000 per day, are of very modern design and appearance and these features have been made possible largely by the use of the pressure die casting process for the production of such components as arm and bed castings, among a wide variety of other sewing machine parts. A new foundry has recently been started, in which all the die castings—70 per cent of aluminium and the remainder of zinc alloys—are now made, and the output is approximately 50 tons of good castings per month. In this article, which is the first of two, details are given of the layout and organization. Melting of both aluminium scrap and ingot material is carried out in a single furnace which is fired from natural methane gas at a very economical cost. Only two standard aluminium alloys are employed, one for intricate castings, and the other for simple shapes. Analysis is carried out by spectrophotometric methods. Most of the die castings are made on Triulzi water-hydraulic machines. In addition, there are two Bühler and one Idra oil-hydraulic machines. Handling of castings has been mechanized as far as possible, and conveyors are provided in both the casting and fettling areas. A die for a material support casting of simple shape, operated on the Bühler 400-ton machine, has an angle-pin-operated core which is completely enclosed within the cavity when the die is shut. (MACHINERY, 92—28/2/58.)

Handling and Storage Arrangements at the Timken Shipping Centre ...... P. 508

The Timken Roller Bearing Co., U.S.A., have established a shipping centre at Bucyrus, Ohio, as part of an integral system for recording and executing orders, controlling stocks, and despatching bearings. At the centre, highly efficient arrangements have been made for the reception of bearings from the various manufacturing plants, and packaging and packing in readiness for consignment to customers. (MACHINERY, 92—28/2/58.)

Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

The Need for Engineering Apprentices

There is every reason to suppose that the current trend, whereby the metal working industries continue to assume increasing relative importance in both the internal and external economy of the country, will persist and even be accentuated. On the one hand, there is a growing demand for metal consumer goods of all types, and on the other, the machine building industries must be prepared to meet the need for more intensive automation, not only in metal working factories, but in those concerned with products of every kind. At the same time, capacity must be available to satisfy the expanding requirements for equipment for power generation, transport, civil engineering, agriculture, and mining.

To a large extent, then, future progress in all fields of industrial activity will depend on the numbers and qualifications of those available for employment in the metal trades, and more particularly upon a sufficiency of skill for the tasks involved in the construction of machines and equipment of progressively greater accuracy and complexity. Automation can provide for a rapid expansion of the average output of those employed in industry, but it will necessitate an overall increase in the number of skilled engineering workers.

In recent years, much has been heard of the need for more people with advanced technical training who can conduct research in old and new sciences, turn the latest discoveries to practical account, design better machinery, and develop and apply improved production processes. This need is very real, but it is equally essential that there should be sufficient skilled workers to translate the ideas of the technicians into reality on the necessary scale. The skills demanded can only be attained by intensive practical training, and although the emphasis is continually changing, many tasks remain which must be entrusted to those who have had a thorough grounding in craftsmanship.

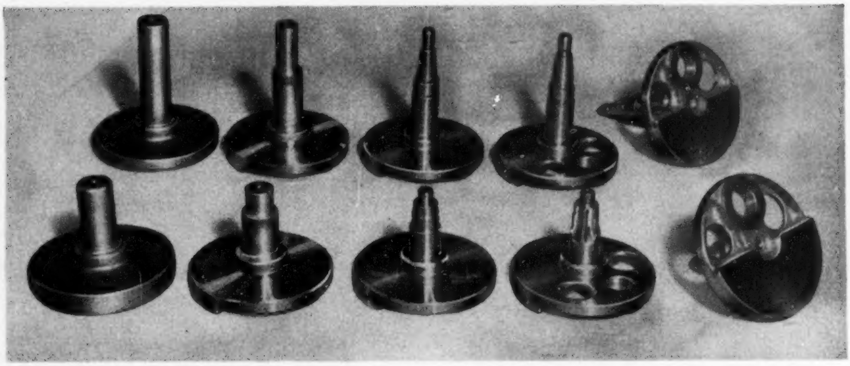
It follows that if the necessary automation equipment is to be provided and effectively maintained in the future, more apprentices must be trained by engineering firms, and especially by those whose products demand the highest standards of skill for their execution. Obviously the machine tool, and the gauge and tool, industries, are particularly dependent on the skill of those employed, and it is here that the recruitment and training of adequate numbers of apprentices can yield results of the greatest value, in view of the rapid expansion of these industries that must inevitably take place during the next decade.

As is explained in a report by a sub-committee of the National Joint Advisory Council, which has recently been issued under the title Training for Skill, exceptional and non-recurring opportunities for recruiting apprentices will arise during the next six years, by reason of the larger numbers of boys and girls who will be reaching the age of 15 in each year. This report, to which further reference is made elsewhere in this issue of MACHINERY, deserves careful study. It necessarily covers a wider field than that with which we are here principally concerned, but many of the conclusions and recommendations appear to apply with particular force to the metal-working industries.

A somewhat disconcerting fact which emerges is that the main difficulty of the sub-committee in assessing the adequacy of intake into craft apprenticeships was "the almost complete absence of reliable statistics." In the course of the enquiry, each industry was asked to say how many craftsmen and apprentices it had. "Few industries were able to answer that question with any precision, and many were unable to supply any sort of answer at all."

One very important matter which is discussed is the collective responsibility of an industry for training its young workers. Some firms, it is pointed out, do not at present train apprentices "because they find it cheaper to take on as adults those whom others have trained." In many instances, however, there may be valid reasons why no contribution has hitherto been made towards the training of apprentices. For example, a small firm may be unable to give the whole range of training required. One solution to this problem, to which attention is drawn, is the group apprenticeship scheme, whereby a boy apprenticed to one firm receives parts of his training with other firms in the group. It is also suggested that some companies which are too small individually to provide works apprenticeship schools, such as are maintained by many of the larger firms, might combine in groups to establish joint training centres. Similar results could also be achieved by

(*Continued on page* 518)



The Production of Components for Lambretta Motor Scooters

Methods Employed in the Innocenti Works, Milan, Italy

The history and the internal organization of the company known as Innocenti, S.G., and their large factory in the Lambrate district of Milan, Italy, were briefly discussed in an article published in MACHINERY, 92/60—10/1/58. This article also gave details of the current design of Lambretta motor scooters, and of the methods employed by the company for the manufacture of pistons for the two-stroke engines. Other articles, in MACHINERY, 92/176—24/1/58 and 92/292—7/2/58, were concerned with the production of finned cylinders, and connecting rod and crankshaft components, respectively. In this fourth article, details are given of the final operations on the crankshaft components and of their assembly, with connecting rods, into complete crankshafts, also of finishing operations on the assembled shafts.

Some stages in the production of the crankshaft components, which are generally similar, except that one has a longer shaft portion than the other, are seen in the heading illustration. It may be recalled that these components are machined from steel stampings, by a series of operations which includes milling the ends of the shaft portions to length, rough and finish copy-turning the shafts and facing the counter-weight flanges, drilling lightening holes in the flanges, and drilling and reaming the holes for the insertion of the crank-pin whereby the two parts are held together. Two finished shaft components are seen at the right-hand ends of their respective rows in the heading illustration, and the previous article was concerned with the machining operations up to the stage represented by the component next to the right-hand end in each row.

After the driving splines have been hobbed at the end of the shorter of the two shaft components, they are both taken to a Ferrari (Robert Speck, Ltd.) cylindrical grinding machine, on which the largest shaft diameter, adjacent to the counter-weight flange, is finish-ground square with the flange face. In the final assembly, these surfaces are engaged by oil seals, so that they must be accurately finished, and as a preliminary to a subsequent super-finishing operation they are ground to the common diameter of $31{\cdot}3 + 0{\cdot}000 - 0{\cdot}03$ mm. ($1{\cdot}2323 + 0{\cdot}000 - 0{\cdot}0012$ in.). This operation is carried out with the aid of an Etamic (Wickman, Ltd.) caliper-type grinding gauge, which incorporates a panel with a red, a white, and a green light. These lights are illuminated in turn, as the grinding operation proceeds, green indicating that the diameter is oversize, white, that the in-feed of the wheel-head has stopped and sparking-out is in progress, and red, that the component has been finished to the required size. When the grinding operation has been completed, as indicated by the caliper in contact with the ground portion of the work, a solenoid is energized to move a lever, and the wheelhead is retracted. A Norton 38A-60M-5V specification wheel is employed, and

is run at 6,500 ft. per min. The work spindle is driven by a D.C. motor supplied from a generator set, and its speed can be steplessly varied between 75 and 750 r.p.m. For this operation, the speed is 450 r.p.m. Only a light contact of the side of the wheel with the outside edge of the concave face of the flange is required to ensure that this face, which is about ⅜ in. wide, is square with the ground oil seal surface.

Two Felice Rassetti, vertical spindle, surface grinding machines are employed for the next two operations on the shaft components, which comprise grinding the faces on the opposite sides to the shaft projections. One of the machines is used for the semi-circular surface of the counter-weight, as seen in the heading illustration, and the other for the boss surrounding the crank-pin bore, since these two surfaces are at slightly different levels.

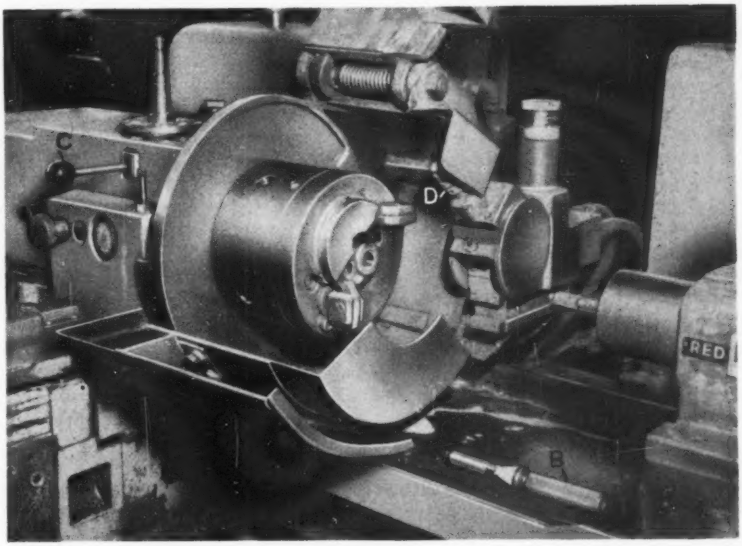


Fig. 2. On this Heald Gage-Matic Internal Grinding Machine, the Bore into which the End of the Crank-pin is to be Pressed is Finished to a Diameter of 20 + 0·021 − 0·000 mm. (0·7874 + 0·00084 − 0·000 in.)

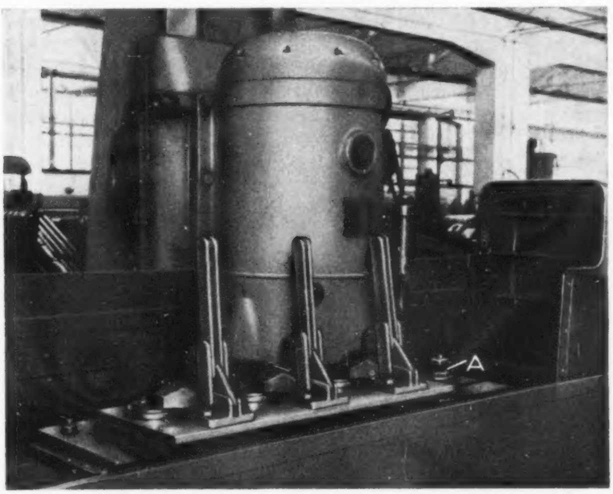


Fig. 1. One of the Two Felice Rassetti Vertical Spindle Machines Employed for Surface Grinding the Counterweight Faces which will be Innermost in the Final Assembly. The Fixture Holds Six Components

The set-up for the second of these operations is shown in Fig. 1, and it will be seen that the machine table carries a fixture designed to hold six components. The shaft portions are accommodated in bores in the fixture, and location is taken from the 31-mm. diameter ground at the previous operation. For angular positioning, a stub dowel engages the crank-pin bore, and each pair of components is secured to the surface of the fixture plate by means of a substantial toggle clamp, the pressure being applied through a large pad. An 8-segment wheel of 13¾ in. outside diameter is employed, and is run at 1,600 r.p.m. The wheelhead is fed downwards, automatically, at the end of each double reciprocation of the table, in increments of 0·003 in. A diamond in a holder A, on the table, controls the thickness to which the component flanges are ground. The other machine, for grinding the semi-circular surfaces, is

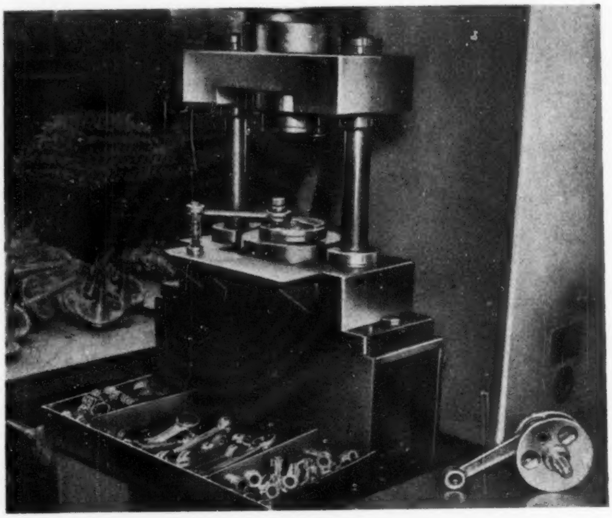


Fig. 4. Assembly of the Crankshaft Components is Carried Out on this Galdabini Press of 20 Metric Tons Capacity, which is Equipped with a Special Positioning Fixture

equipped with a somewhat similar fixture, which also accommodates six components.

At the final operation on the crankshaft components, the holes for the crank-pins are finished on a Heald Gage-Matic (Alfred Herbert, Ltd.) internal grinding machine, with the set-up shown in Fig. 2. Location is again taken from the 31-mm. oil seal diameter, the shaft being accommodated in an off-set bore in the chuck, and the angular position of the bore to be ground is accurately set with the aid of the small arbor *B*. This arbor has a plain cylindrical portion which is a good fit in a hole in the chuck, in line with the position to be occupied by the bore to be ground. Adjacent to this cylindrical section, there is a tapered portion, the larger end of which is too big to pass through the crank-pin bore. When this arbor is passed through the bore to be ground, and into the hole in the chuck, the tapered portion comes into contact with the crank-pin bore and centralizes it in relation to the chuck hole. Hydraulically-operated clamps, which have a turning action so that they clear the work in the retracted position, are then applied by means of the ball-lever *C*, which may be seen at the left.

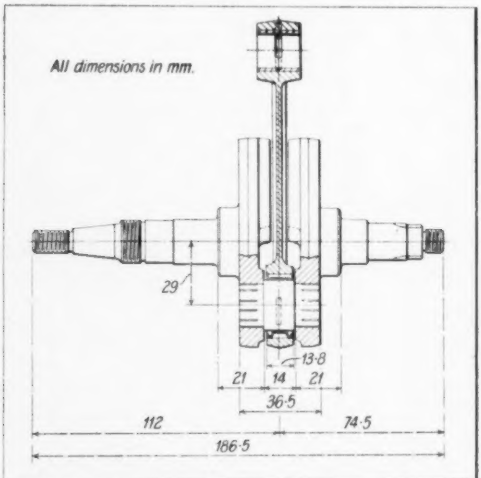


Fig. 3. Arrangement of the Crankshaft and Connecting Rod Sub-assembly. The Ends of the Crank-pin are a Force Fit in Their Bores and Serve to Hold the Two Portions of the Shaft Together

A Norton grinding wheel of A54-M5-VBE specification is employed for finishing the bore, and is run at a speed of 27,000 r.p.m. on the spindle of the Red Head unit, seen at the right in Fig. 2. The work is rotated at 250 r.p.m., and during the preliminary roughing stage of the automatic cycle, which involves about 56 reciprocations of the wheel spindle, most of the 0·5 mm. (0·020 in.), left on the bore diameter at the reaming stage, is removed. The wheel is worn to the extent of about 0·0003 in. (on the radius) during this stage, and is redressed by the diamond in the holder seen retracted at *D*, which is lowered hydraulically into the dressing position. A further 21 reciprocations then suffice to enlarge the bore to the required dimension of 20 +0·021 −0·000 mm. (0·7874 +0·00084 −0·000 in.). All the operations here described are common to both shafts and are performed on the same machines, and after the bores have been finish ground, the shafts are deburred by hand before being inspected.

CRANKSHAFT ASSEMBLY

A drawing of the complete crankshaft and connecting rod sub-assembly is shown in Fig. 3, and it will be observed that the two shaft components are held together by a crank-pin, the reduced ends of which are pressed into the holes in the counter-

weights, ground at the last operation. The ends of the pin have a diameter of 20·2 +0·02 −0·00 mm. (0·7953 +0·0008 −0·000 in.), and they are provided with a number of shallow, longitudinal grooves, which facilitate the escape of air and lubricant during the assembly operation. The central portion of the crank-pin has a diameter of 22 −0·02 −0·038 mm. (0·8661 −0·0008 −0·0015 in.), and is 14 mm. long, so that there is a nominal clearance of 0·2 mm. (0·008 in.), for the large end of the connecting rod, which is 13·8 mm. thick.

As explained in an earlier article, the large-end connecting rod bore forms the outer race, and the crank-pin the inner race, of a needle roller bearing, with 17 rollers of 3 mm. diameter, in a pressed steel cage. The radial bearing clearance is held to limits of 0·008 to 0·025 mm. (0·00031 to 0·001 in.), and, to this end, the components are graded during inspection, and numbered 1, 2 or 3. For a particular assembly, components having numbers which add up to a total of five are selected, and it is thus ensured that the clearance will be within the specified limits.

For assembling the crankshafts, a Galdabini [Cyril Adams & Co. (Special Projects), Ltd.] hydraulic press of 20 metric tons capacity is employed and is fitted with the special fixture shown in the close-up view, Fig. 4. The lower portion of this fixture is supported on a weld-fabricated steel box structure, and incorporates a circular block with an accurately finished bore. The crankshaft component with the longer shaft portion, seen on the left in Fig. 3, is loaded with the ground oil seal surface, mentioned earlier, located in the bore in the block. In this position, the shaft enters the jaws of an air-operated collet chuck, and when this chuck is operated by means of a hand-operated valve on the side of the press, the shaft is gripped on the main bearing diameter, adjacent to the oil seal surface. Angular location of the component is obtained, before the collet chuck is closed, by means of a spring-loaded pin which enters the crank-pin bore from beneath. This pin is pushed downwards, into its housing in the block, by the end of the crank-pin, as the latter enters the bore in the crankshaft. A centre point, on the upper surface of the spring-loaded pin, provides a location for the drilled crank-pin, which is fitted with a set of rollers in a cage, and a connecting rod, from the trays in front of the press, before being loaded.

The connecting rod is supported, and the crank-pin held in alignment with the bore which it is to enter, by an outboard post which is a sliding fit in the small end bore. This post is provided with a compression spring, which holds the rod at the correct level during the loading operation, and allows it to move downwards when the press pushes the crank-pin into the bore. A plate attached to the press ram carries a steel block somewhat similar to that incorporated in the lower part of the tool, and similar arrangements are employed to locate and clamp the shorter of the shaft components in position. Guide pillars fitted at either side of the lower circular block pass up through bushes in the plate carrying the upper tool, and serve to ensure that the movement of the press ram is parallel with the axes of the shaft portions of both components.

When the press is started, the ram is lowered, under the control of the operator, until the centre point of the upper locating pin is engaged with the upper end of the crank-pin. Further downward movement of the ram then causes the reduced diameter ends of the crank-pin to enter the bores in the two crankshaft components. Slight chamfers on the ends of the pin, and in the bores, facilitate starting, and a pressure of the order of 7 tons is usually required to complete assembly. A view of two sub-assemblies is given in Fig. 5.

Several important operations are carried out after the shaft components have finally been assembled, and since certain of these operations

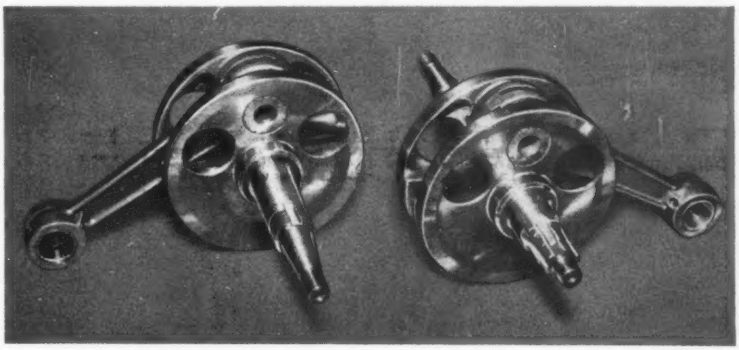


Fig. 5. These Two Completed Crankshaft Sub-assemblies Indicate the High Degree of Finish Normally Imparted to Lambretta Engine Components. They are Shown in the Condition in which they are Assembled in the Engine

are performed with the shaft held between centres, the first step is to re-cut the centres to ensure that they are true with the main shaft diameters. Re-centring is carried out on the special Innocenti-built machine illustrated in Fig. 6, which is equipped with two horizontal spindles, driven at 1,000 r.p.m. from motors mounted above, through V-belts and bevel gears. The inner end of each spindle is fitted with a collet chuck holding a centre drill, and the spindles can be moved towards or away from each other, for the centring operation, by means of the two ball-handled levers *E*. When loading the machine, the sub-assembly is placed with the crank-pin to the rear, and with the connecting rod engaged in a U-shaped supporting structure above. In this position, the shaft rests with two oil seal surfaces on top of mushroom-headed pins which project upwards from each side of a block *F*. The two pins are made as a single U-shaped piece, which is pivoted, at its centre, in a slot in the block, so that slight misalignment is taken up by movement of the pivot.

At the rear of the block *F*, there are two independently-mounted slides, which can be moved in a direction parallel to the shaft axis. The end of each slide is formed with a projection, in which there is a centre point, and these centres are moved inwards to engage the chamfered ends of the bore in the crank-pin. Then, the slides are locked in position by means of clamp nuts applied by the two levers *G*. In this position, the crank-pin is correctly aligned with the axes of the cutter spindles, and the shaft axes are at the correct height. A toggle clamp *H* is next applied, to hold the sub-assembly in position for the centring operation. This clamp has a pivoted member *J*, at the upper end of which there is a cross bar, and the ends of this bar are first engaged in slots *K*, in projections from the front of the block wherein the small end of the connecting rod is accommodated. Beneath the cross bar, there is a pressure pad, which is pivoted to allow for slight misalignment of the crankshaft, and this pad is now applied to the top surfaces of the counterweights, by a further movement of the lever *H* towards the machine.

Only light pressure is applied by the clamp to avoid disturbing the accurate setting of the crankshaft. The two drill-spindles are then brought in, slowly and carefully, to re-cut the centre holes in the shaft ends. After this operation, sample shafts are tested by supporting them between centres and applying dial indicators to the oil seal surfaces, to check for run-out. Should the run-out begin to exceed the maximum value that is acceptable, the positions of the centre drills relative to the shaft may be adjusted in the horizontal direction by moving the entire drilling heads, each of which is mounted on L-section ways and equipped with a screw for this purpose. Adjustments in the vertical direction are effected by moving the fixture bodily on its mounting brackets, after unfastening clamping nuts.

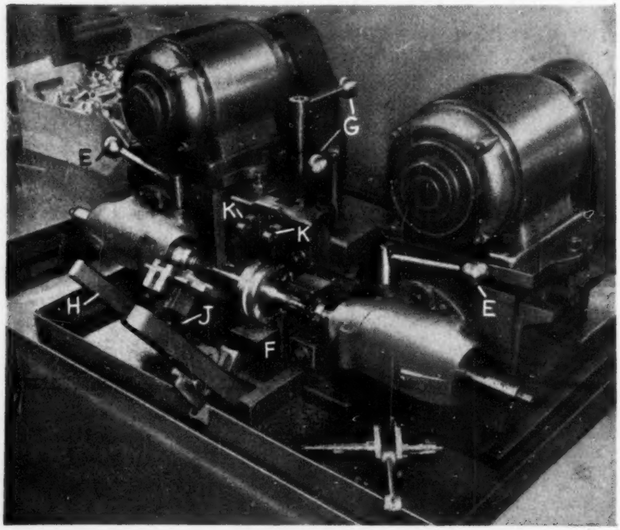


Fig. 6. Re-cutting the Shaft Centre-holes on a Special Machine in Readiness for the Series of Grinding and Other Operations Carried Out on Crankshaft Sub-assemblies

KEYWAY MILLING MACHINE

After the re-centring operation, the crankshafts pass to another Innocenti-built machine, designed for milling two keyways on the longer of the two shaft portions. Details of these keyways were given in the drawing of the components which accompanied the previous article, and one of them may be seen on the shaft portion of the left-hand assembly in Fig. 5. This keyway accommodates the tab of a locker-washer in the final assembly, and it is cut in a part of the shaft which is later threaded 19-mm. (0·748-in.) diameter by 1-mm. (0·040-in.) pitch. The other keyway cut on this machine is of the Woodruff form, and is produced with

a cutter of 10 mm. (0·4 in.) diameter. This keyway, which is 2·5 mm. (0·098 in.) deep by 3 mm. (0·118 in.) wide, is in a plane at an angle of 18 deg. to that of the first keyway, is on the opposite side of the shaft and in the tapered portion. It may be noted that this tapered portion carries the cooling fan and the flywheel magneto, in the final assembly.

A view of the machine employed for cutting the keyways is given in Fig. 7. It is largely of weld-fabricated construction, with a flat top, near the centre of which the fixture is mounted. The fixture is shown loaded, but with the clamp retracted, and it will be observed that the component is supported on the re-cut centres, in a vertical position, with the longer shaft portion downwards. The lower centre is carried in a bracket at the base of the fixture, and the upper point, which is retractable for loading, in an overhanging bracket. Angular location of the shaft is obtained from the chamfered bore of the crank-pin, which engages a centre point projecting upwards from the main support plate of the fixture. Just above this plate, and surrounding the circular flanges of the counterweights, is an annular ring *L*, which is supported on coil springs. A portion of this ring is offset, to provide a positioning channel for the connecting rod.

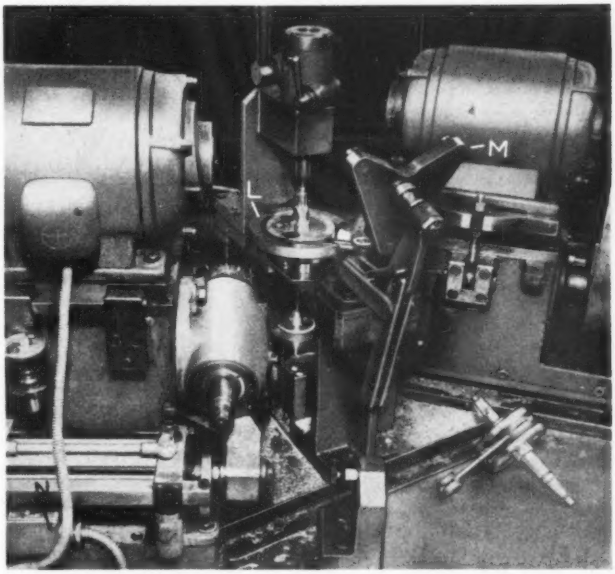


Fig. 7. On this Special Machine for Milling Keyways, the Cutter Heads are Advanced with the Aid of Air-hydraulic Cylinders one of which is Seen in the Left Foreground. The Sub-assembly is Accurately Located in a Fixture

In the main plate of the fixture, beneath the ring *L*, there are three bushes, housing pins, which are approximately equally-spaced round the component. The upper ends of the pins are screwed into the ring, and their lower ends project beneath the plate surface. Adjacent to each of these pins, there is another, horizontal pin, which is spring-loaded outwards, and the mating ends of each pair of pins are machined at 45 deg. to form cam surfaces. The inner ends of the horizontal pins are level with the ground oil seal surface on the lower shaft. When the ring *L* is pushed downwards, the ends of the horizontal pins are thrust inwards against the oil seal surface to steady the central portion of the assembly. Pressure is applied to the ring by means of the triangular-shaped plate *M*, attached to the arm of the toggle clamp, which is moved into position after the tailstock centre has been applied and locked.

Two similar milling heads, of the same design as those on the machine in Fig. 6, are employed for cutting the keyways. The head at the right in Fig 7 is fitted with a 10-mm. cutter, which is driven at 560 r.p.m., for cutting the Woodruff keyway. For the plain keyway, a cutter of 60 mm. (2·362 in.) diameter with 20 teeth is employed, and is driven at 140 r.p.m. This keyway, it may be noted, has a radius at the bottom equal to that of the cutter. Both the heads are fed by means of hydro-check air cylinders, part of the cylinder for the left-hand head being seen in the foreground in Fig. 7. As explained in an earlier article, these cylinders were supplied by Arco, of Milan, and they provide for a fast approach of the head to the work, followed by a slow feed movement, which can be steplessly varied by the adjustment of a valve. Each milling head is fed to a stop before it is retracted, the reversal of the solenoid valve for controlling the direction of the air supply to the feed cylinder being effected by a limit switch, as seen at *N*. This switch is operated by a projection on the under-side of the square-section bar above it, which is carried along by the cylinder ram as it advances the head.

From the previous article, it may be recalled that the faces of the counterweights on the shaft sides are concave, and during the early operations

they are machined at an angle of 3 deg. Since the ends of the crank-pin are machined square with its axis, it is necessary to remove the excess material which projects beyond the counterweight surface, and this operation is carried out on a Ferrari (Robert Speck, Ltd.), universal grinding machine, with the shaft held between centres. A special clamp of sheet metal is applied to hold the connecting rod in the central position, and grinding is performed with the side of the wheel, the head being set over at a slight angle so that the wheel clears the counterweight surface. Following this operation, the various shaft diameters are finish-ground on a pair of Fortuna-Werke (Vaughan Associates, Ltd.) cylindrical machines. A total of five diameters is ground on the shorter shaft portion (on the right in Fig. 3) on the first machine, and the assemblies are then transferred to the second machine, which is illustrated in Fig. 8. In this machine, five diameters and a taper on the longer shaft portion are ground simultaneously, ranging from the oil seal surface, which is finished to 31 −0·000 −0·039 mm. (1·2205 −0·000 −0·0015 in.) diameter, to the end step, which is to be roll-threaded, and is ground to 9·35 −0·010 −0·050 mm. (0·368 − 0·0004 −0·002 in.) diameter. The taper, it may be noted, is 22 mm. (0·8661 in.) long, and the diameters at the small and large ends are 10·6 mm. (0·4173 in.) and 15 mm. (0·5905 in.).

For grinding the various diameters and the taper, a form-dressed wheel is employed, and some details of the dressing equipment may be seen in the close-up view shown in Fig. 9. The dressing diamond, carried by a horizontal hydraulically-operated slide, is raised and lowered under the control of the template *P*, to form the wheel in the required outline. A Norton wheel of A54-N8-VBE specification is employed, and is run at 1,200 to 1,400 r.p.m., depending on the amount of wear that has taken place, a surface speed of about 6,300 ft. per min. being maintained. The assembly is held between centres, the shorter shaft portion being surrounded by a cage-member, which has a slotted projection to hold the connecting rod, also a centre point to engage the crank-pin bore and thus provide the drive. Grinding is carried out at a work speed of 132 r.p.m., and the operation is completed in a floor-to-floor time of 2 min. In-feed of the wheel-head is controlled by a Finitor caliper gauging head, mounted on the machine table, seen in the foreground in Fig. 9. This unit is advanced hydraulically at the start of the automatic grinding cycle, to engage the measuring anvils with the main bearing diameter adjacent to the oil seal surface. When this diameter has been reduced to 20 −0·000 −0·013 mm. (0·787 −0·000 −0·0005 in.), the wheel-head is retracted, and the gauging head withdrawn, so that the work can be unloaded.

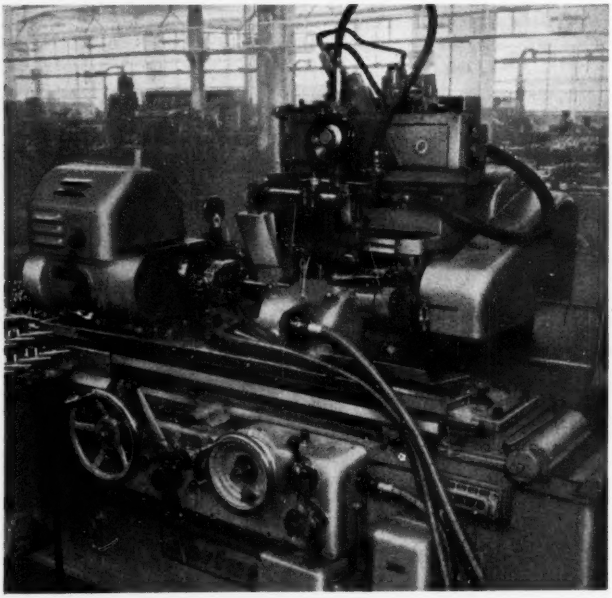


Fig. 8. One of a Pair of Fortuna-Werke Cylindrical Grinding Machines, with Form-dressing Attachments, for Finish-grinding Five Surfaces on the Splined, and Six Surfaces on the Taper, End of the Sub-assembly

THREAD MILLING

Following the two grinding operations on the shaft portions, the sub-assemblies pass to the Innocenti-built thread-milling machine shown in Fig. 10, on which the thread on the diameter adjacent to the large end of the taper is cut. This machine is of similar design to that described in connection with the production of finned cylinders in one of the earlier articles, and it has a spindle at the left carrying a fixture to accommodate the work. In this fixture, the sub-assembly is first located by a centre point at the left-hand end, before the main bearing and the adjacent dia-

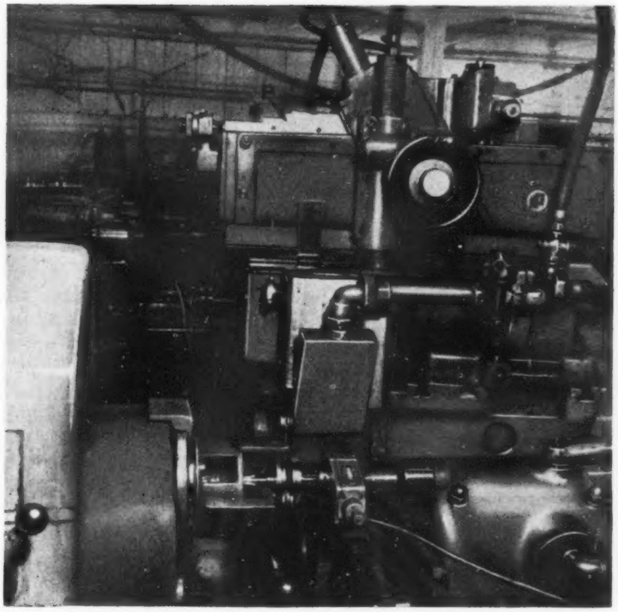


Fig. 9. In this Close-up of the Fortuna-Werke Machine Employed for Grinding the Taper End of the Crankshaft, the Template *P* for Controlling the Wheel Form, May be Seen, also the Finitor Caliper Gauging Head

meter at the opposite end are inserted in one half of a split, bronze bush in the projecting portion of the fixture. The other half of the bronze bush is carried in a swinging clamp, which is next brought down and locked in position by a substantial wing nut. A groove in one side of the fixture accommodates the connecting rod, which is anchored for the machining operation by a small spring-loaded bayonet pin *R*, shown in the retracted position.

The spindle carrying the fixture is driven through reduction gearing at a speed of one rev. in 70 sec., and the same motor drives the cutter spindle at the right, also a cam and leadscrew which control the movements of the work-head. A long arbor is provided, so that the cutter clears the projecting taper portion of the shaft, and the spindle is run at a speed of 250 r.p.m. The 19-mm. (0·748-in.) diameter by 1-mm. (0·039-in.) pitch thread is milled with a 27-mm. (1·063-in.) diameter by 20-mm. (0·787-in.) long cutter, which has eight straight gashes. After the sub-assembly has been loaded, the work-head is moved to the right, against a stop, to a position in which the end of the diameter to be thread-milled overlaps the end of the hob by a distance equal to the length of the required thread, less one pitch. The automatic cycle of the machine is then started by pressing a button, and the work-spindle is driven through slightly more than one complete revolution, after which the motor is switched off. At the start of the cycle, the work is fed sideways towards the cutter by the cam, to the required depth, after which it is traversed longitudinally through a distance of 1 mm., and finally withdrawn. A lard oil mixture is employed to lubricate and cool the cutter.

SPLINE GRINDING

For accurately finish-grinding the splines on the shorter shaft portion, the Werner (Rockwell Machine Tool Co., Ltd.) machine illustrated in

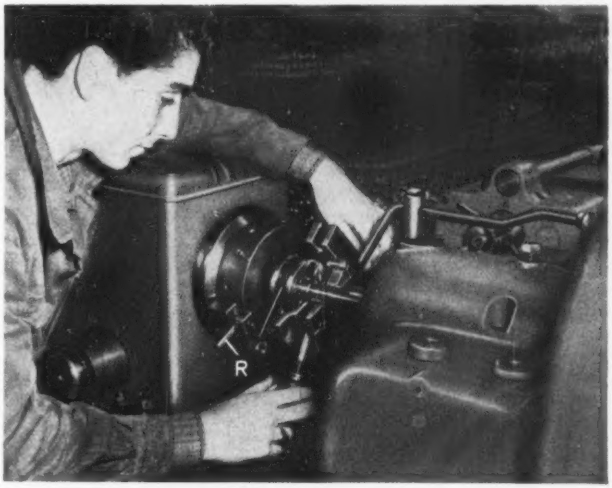


Fig. 10. Loading the Fixture on the Innocenti-built Thread-milling Machine Employed for Cutting a Thread on the Magneto End of the Shaft

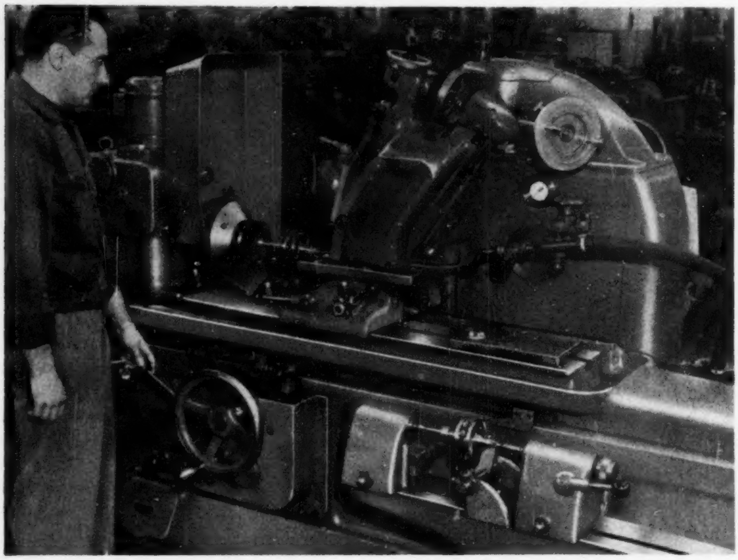


Fig. 11. The Six Splines on the Driving End of the Shaft are Finish-ground on this Werner Machine, which is Equipped for Automatic Indexing and Down-feed of the Wheel-head

Fig. 11 is employed. There are six splines, each 3·5 – 0·005 – 0·025 mm. (0·1378 – 0·0002 – 0·001 in.) wide, and with major and minor diameters of 16 and 13 mm. (0·6299 and 0·5118 in.). Before being placed in the machine, each assembly is fitted with a driving collar, in the correct angular position relative to the existing splines, with the aid of the equipment seen mounted at the front of the bed in Fig. 11. This equipment incorporates centres to support the work, and a swivelling blade, which can be raised by means of a lever, to engage one of the spline grooves. Before placing the assembly between the centres, a driving collar is fitted to the longer shaft portion. This collar is mounted on the step adjacent to the main bearing diameter, and has an L-shaped projection which is engaged with a slot in a bracket on the adjacent centre support.

With the swivelling blade engaged in one of the spline grooves, the clamping screw of the driving collar is tightened, and the assembly is then ready for loading between the centres of the grinding machine. When the work is in position, the L-shaped projection is engaged by a spring-loaded ball on one side of a slot in a bracket, which is attached to the work-spindle for indexing purposes. This machine is equipped with a single grinding wheel, which is driven at 8,000 r.p.m., and is employed to grind both sides and the bottom of each groove. Dressing is carried out with three diamonds which are installed inside the cover seen above the grinding wheel in Fig. 11. Two of these diamonds are arranged to dress the sides of the wheel at an included angle of 60 deg. The third diamond is carried by a radius-dressing unit, and is employed to dress the wheel face to a radius of 6·5 mm. (0·2559 in.). The work is automatically indexed after each double stroke of the table during the grinding operation, and the wheelhead is fed downwards, automatically, after each complete revolution of the work. Feed is applied in increments of about 0·005 mm. (0·0002 in.) for three or four passes, and in steps of about 0·002 mm. (0·008 in.), for the final passes. Ring gauges are used to check the progress of the operation.

As mentioned earlier, the small diameter at the end of the tapered portion of the shaft is threaded 10 mm. (0·3937 in.) diameter by 1 mm. (0·039 in.) pitch, over its length of 13 mm. (0·5118 in.). In addition, the splined end of the shaft is roll-threaded to the same size, but with a left-hand thread, and both these operations are performed on a Magnaghi machine of conventional design, shown in Fig. 12, which is here set up for the right-hand thread. The components are handled in batches, the rolls being changed at intervals of a few hours so that there is little interference with production. In the machine, the shaft is held between centres, one of which is supported on an outboard bracket, and the connecting rod is held up, clear of the supports, by a long coil spring attached to a bracket above. Rolls of 176 mm. (6·929 in.) diameter are employed, and are driven at a speed of 20 r.p.m. by a 4 h.p. motor. The floor-to-floor time for this operation is 24 sec.

SUPER-FINISHING OPERATION

The final operation on the crankshaft sub-assembly provides for super-finishing the oil seal

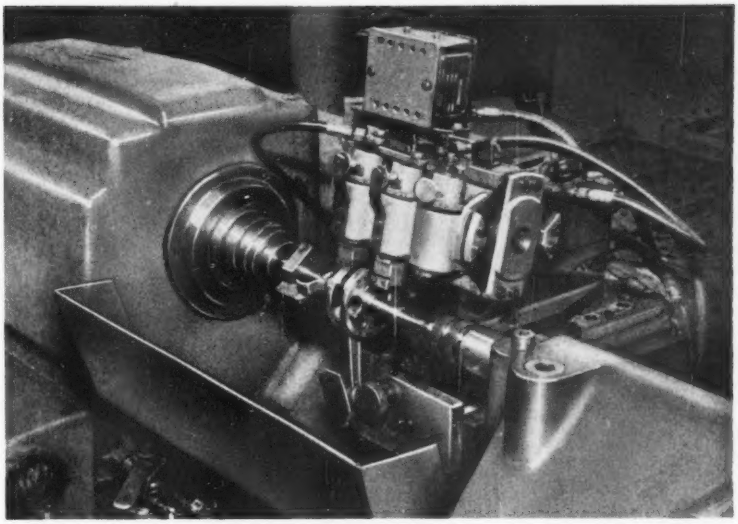


Fig. 13. For Super-finishing the Oil Seal Diameters Adjacent to the Counter-weight Faces, an Air-operated Attachment is Employed on an Adapted Innocenti-built Lathe. A Finish of the Order of 2 Micro-inches is Obtained

surfaces adjacent to the counter-weight flanges, to ensure that the seals will be effective and will have a long life. This operation is carried out on an adapted Innocenti-built lathe, as shown in Fig. 13, with the shaft held between centres and driven at a slow speed. The super-finishing unit is mounted on the rear tool-slide of the lathe. In this attachment, the super-finishing stones, which measure 6 by 13 by 18 mm. (0·24 by 0·5 by 0·7 in.), are held in clamps, of which only two out of three are in use. The clamps are attached to the body of an air cylinder of special design, which can be reciprocated on the stationary, horizontally-mounted ram. At each end, the cylinder is attached to leaf springs whereby its movement is restrained, and it is connected through special valves to the shop air supply line. When air is admitted, the cylinder is caused to reciprocate very rapidly, with an amplitude which can be varied, up to a maximum of 2 mm. (0·0787 in.), by regulating the pressure applied. This variation also affects the speed of reciprocation. A mixture of 10 per cent of soluble oil and water is employed to lubricate and cool the stones and the work, and the finish achieved is of the order of 2 micro-inches.

After this operation, the sub-assemblies are washed and inspected before being passed to the track at the end of the machining line for assembly into engines.

The final article, to be published shortly, will include details of the 175-c.c. engine for the latest Lambretta scooter, and of operations on the crankcase.

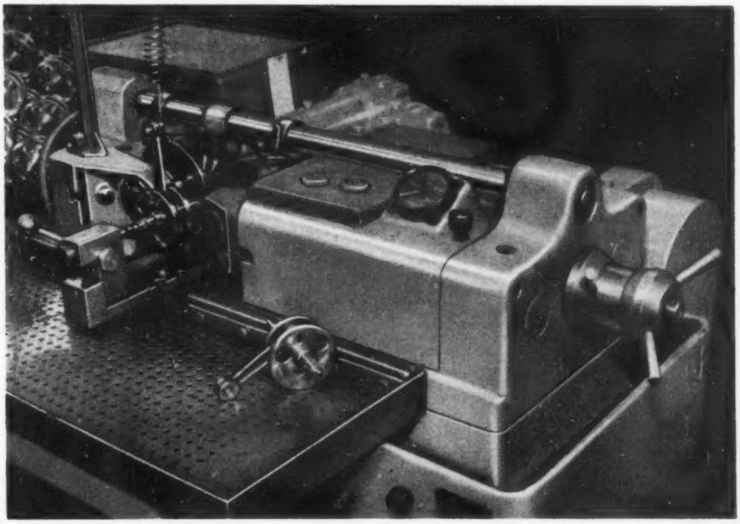


Fig. 12. Set-up on a Magnaghi Thread-rolling Machine for Forming the Right-hand Thread at the Taper End of the Shaft

Mechanical Handling Equipment for Motor Car Body Stampings

By J. NIEMINEN*

The new stamping plant of the Chrysler Corporation, U.S.A., is now rapidly approaching full production. It has an area of 1,740,000 sq. ft., and the cost of the building and equipment was nearly 85 million dollars.

Twenty-eight principal press lines, with a total of 260 presses, many of which are already running, will supply approximately 300 different body stampings to various asembly plants. Five of these presses weigh 600 tons each, and have a capacity of 1,800 tons. The majority weigh 300 to 400 tons and operate at 10 to 30 strokes per min.

The latest mechanical-handling techniques are employed to move parts from press to press. Highly efficient equipment has also been provided for preparing the steel for the presses and for the subsequent welding operations.

One of the first of the important press lines to go into operation, known as line 28, produces Plymouth roof panels. Steel for the panels reaches the plant as flat sheet 72 in. wide, 89 in. long, and 0·039 in. thick. These sheets are first passed through a McKay Flex-Roll machine, on which they are stress-relieved as they follow an undulating path through a series of rolls. Sheets for all external panels for car bodies undergo this treatment prior to drawing, to prevent stretcher strains and fractures in the finished stampings.

Sheets are stacked on a live-roller table in front of the first press in the line, as seen in Fig. 1. The stacks are delivered on pallets, which are carried by rollers to the operator's station. There, each sheet is placed in a loader which shuttles it forward into the die. This Danly 1,000-ton press, of the triple-action under-drive type, performs the first drawing operation.

The pressing, which is drawn upside down, is lifted from the die by air cylinders. A Sahlin air-operated Iron Hand, on the back of the press, then reaches in to extract it. A limit switch on the extractor jaw provides a safety interlock. When a panel is being extracted, this switch breaks the press circuit, so that another cycle cannot be started.

When the roof panel is released by the Iron Hand, it is deposited on a flip-over device, built by the G. and W. Automation Co., Detroit, with the result that it is inverted, and subsequently progresses "right side up."

A shuttle loader moves the panel into a Danly 1,000-ton single-action, under-drive press for re-striking. Air cylinders lift the panel from the re-striking die, and another Iron Hand transfers it to a second

* Chrysler Corporation, U.S.A.

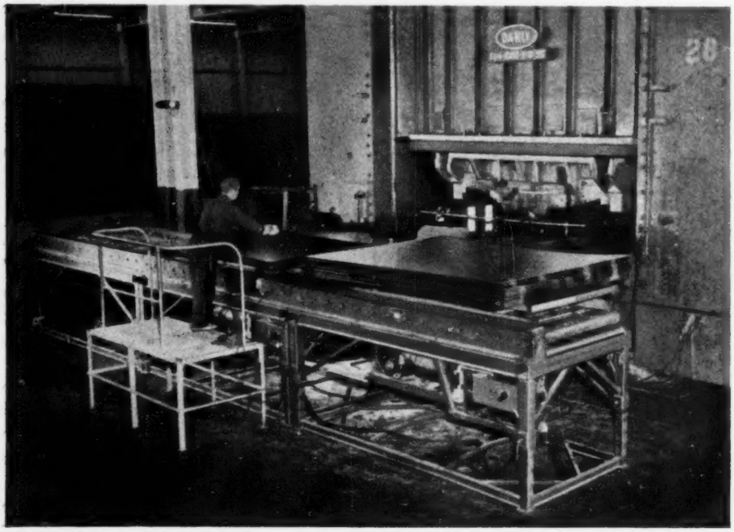


Fig. 1. Roof Pane Sheets are Placed in a Loader at the Front of the Drawing Press

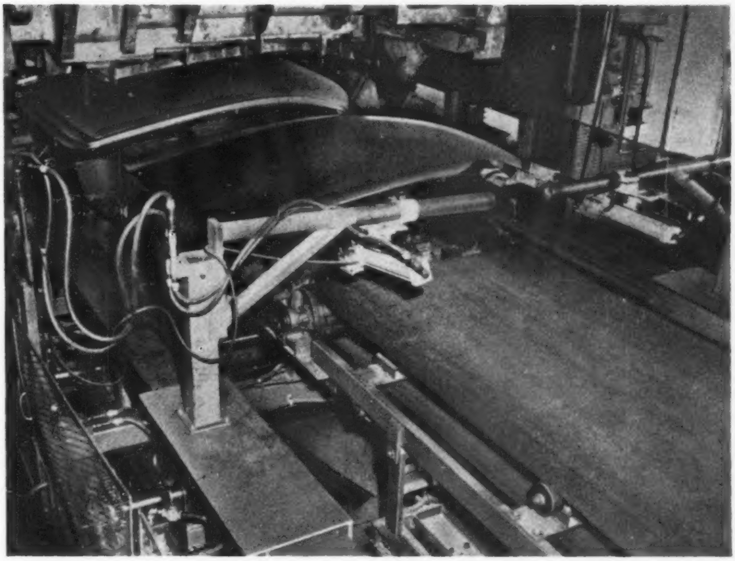


Fig. 2. After They have been Trimmed, the Roof Panels are Pulled on to a Belt Conveyor by Side-arm Extractors

shuttle loader. In the third press, which is of the same type as the second, the excess stock is trimmed off. Side-arm extractors, seen in Fig. 2, move the completed panels on to a belt conveyor. After leaving the conveyor, the panels are inspected and stacked, in readiness for the application of fibre-glass pads to the undersurfaces.

On line 23, some material-handling devices of unusual interest are provided, two of which are shown in Fig. 3 and 4. This line produces Plymouth right-hand rear quarter panels.

The quarter panel is made from 0·040-in. coiled steel sheet. Blanks of parallelogram shape are loaded, long-edge forward, into the press on which they are drawn upside down. On the remainder of the line, however, the parts are handled right side up and short-edge forward. The view of the back of the drawing press in Fig. 3 shows the mechanical handling devices. A dual-jaw Iron Hand extracts the panel from the die, and deposits it in a positioning fixture. The panel is inverted and is then turned through 90 deg., before it is advanced to the next press for rough trimming.

Fig. 4 shows how the panel is extracted from a die by means of vacuum cups. A horizontally-moving bar, carrying two vacuum cups, lifts the panels on to a belt conveyor. All excess metal has been removed at this stage, and the cups grip the panels without damaging the surfaces.

Except for very large parts, such as hood panels

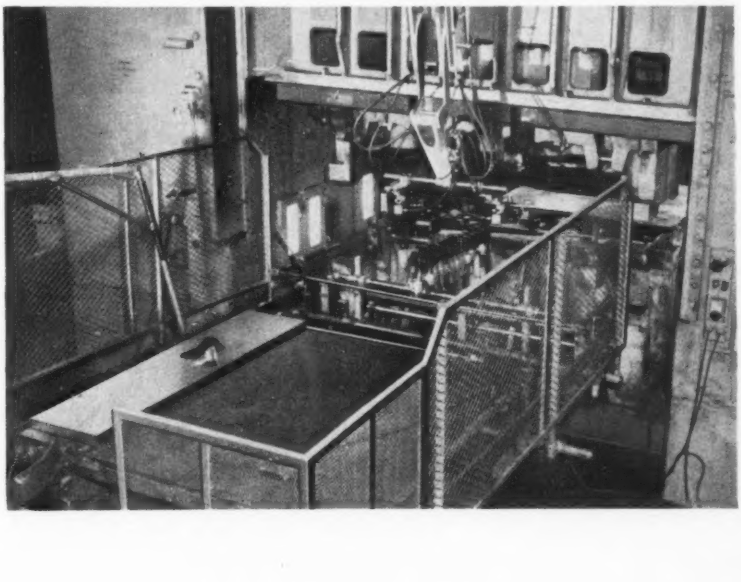


Fig. 3. Handling Devices Invert the Quarter-panel Pressings, and then Turn Them through 90 deg., so that They Move Down the Line Short-edge Forward

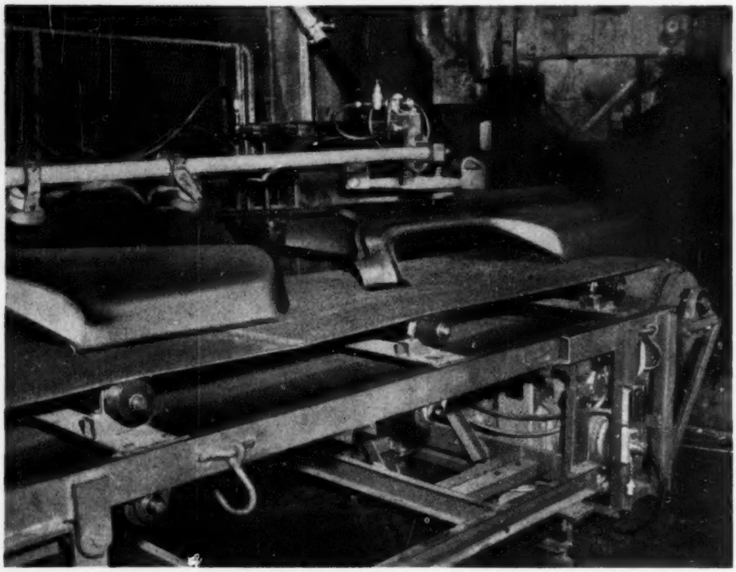


Fig. 4. A Bar Carrying Suction Cups is Moved Horizontally to Extract Panels from a Press and Deposit Them on a Conveyor Without Marring the Surfaces

and roof panels, steel is delivered to the stamping plant in coil form, and is blanked in readiness for drawing.

Each coil is brought in on a motor-driven rail car, and supported horizontally in a holder at the head of one of seven McKay de-coiling lines which feed the blanking presses. As the material unwinds, it is passed through a processing unit, where it is cleaned thoroughly by brush rolls and high-volume sprays of solvent. The solvent also serves as a die lubricant, a film of oil being left on the strip. Cleaning is carried out before the strip passes though any of the sets of opposed flexing rolls in the line, so that dirt and slivers are removed before they can damage the surface of the material.

The material is flexed, as previously described in connection with the roof-panel sheets, after which it passes through wringer rolls, and then enters a levelling and pinch-roll unit. In addition to straightening the strip after it has been flexed, the rolls in this unit, which are motor-driven, serve to pull the material from the coil through the previous rolls.

Next, the strip forms a loop in a storage pit, from which it is drawn by the press feeder unit.

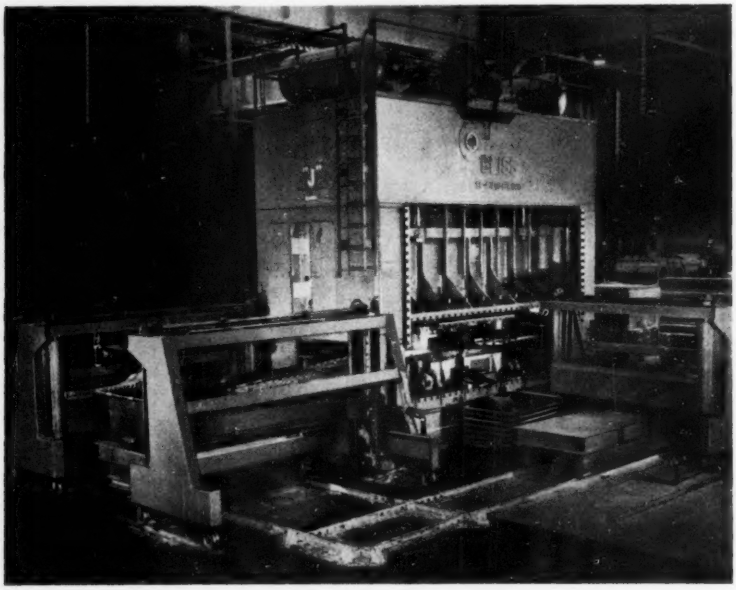


Fig. 5. Strip from the De-coiling Line Enters Through the Right-hand Column of the Press. Discharged Blanks are Passed to Stackers and Transfer Cars

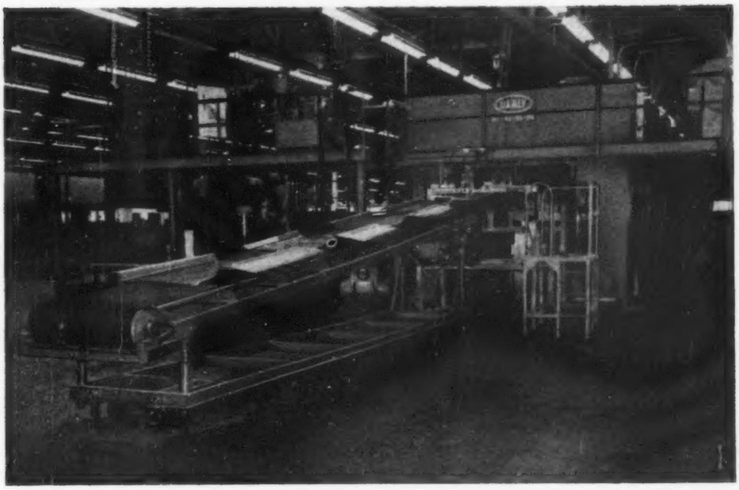


Fig. 6. Floor Pans are Carried on a Belt Conveyor to Four Welding Presses, on which Various Components are Added to Form Assemblies

Photo-electric cell-type sensing devices, at different levels in the walls of the pit, serve to maintain the loop length within a specified range by regulating the decoiling equipment. This line runs at about 200 ft. per min.

Fig. 5 shows a blanking press which is fed by a de-coiling line of the type described. Material is passed through the press sides, from right to left. (Other lines have front-to-back feed.) Here, Plymouth cowl tops are blanked, two per stroke. These particular blanks are discharged through the left side of the press, but in some instances the blanks are discharged from both the left side and the front of the press. At both unloading points, Wean stackers and transfer cars are provided.

Welding of stampings, to form assemblies, keeps pace with production from the press lines. One automated welding installation is seen in Fig. 6, which shows the first unit of a four-press welding line used for the Plymouth rear floor-pan assembly.

Pan stampings move up a belt conveyor to the first unit, where they are spot-welded to side-panel sub-assemblies which enter the press from an auxiliary welding line, seen at the left. The pans are automatically shuttled through the other three presses, on which the fuel tank underbody reinforcement, the fuel tank-filler tube retainer, and the spare wheel anchor-rod bracket are welded in position. The underbody reinforcement, and filler tube retainer, are loaded automatically. Transformers, guns, fixtures, and mechanical handling devices were supplied by the Delta Welder Corporation, Detroit, Michigan, U.S.A.

Handling Equipment for Radioactive Materials

The General Electric Co., U.S.A., are now using a large workshop designed specifically for radioactive materials, which forms part of the test facilities of the Atomic Energy Commission at Idaho Falls. Remotely-controlled handling equipment installed in the shop includes a 100-ton crane and a large capacity mechanical arm, designed and built by the General Electric Co.

The large mechanical arm can handle loads of 500 to 3,000 lb., depending on the arm length and position, and it is suspended from a travelling gantry, in order that it may cover the whole working area of the shop. Operators for this manipulator, and for four other electrically-controlled wall-mounted manipulators, are protected by concrete walls some 7 ft. thick, in which there are nine windows. The windows are 6 ft. thick, and each consists of lead glass and 500 gal. of zinc bromide to absorb stray radiations. Controls are located at each window to operate any piece of servicing equipment in the shop. Radio-contact can be maintained by operators in the control galleries with those at other operating sites, and with a lead-shielded locomotive used to haul equipment into and out of the shop. The track for the locomotive passes through remotely-controlled doors, at one end, and there are smaller entrances to admit workers to the " hot " area.

On the floor of the shop there are two large-capacity turntables for rotating nuclear aircraft propulsion components, to facilitate machining and to allow their various surfaces to be observed. Viewing aids include binoculars, spotting telescopes, mirrors and closed-circuit television, with viewing screens at all operating positions.

L

Sheffield Automatic Assembly and Inspection Machines for Anti-friction Bearings

The range of air-operated gauging equipment made by the Sheffield Corporation, Dayton, Ohio, U.S.A., for checking ball and roller bearings is being extended to include fully- and semi-automatic machines for carrying out assembly as well as inspection operations on most types of precision anti-friction bearings.

One of the new machines for automatically assembling and inspecting taper roller bearings is shown in Fig. 1. On this machine, the inner race is automatically checked for diameter and flange thickness, and rollers of the required size and number are selected from one of six hoppers. Assembly of the race, rollers and cage is next carried out to produce a bearing with a predetermined clearance. The bearing is then checked for torque, " stand out " and noise level, and assemblies which are not acceptable are automatically rejected.

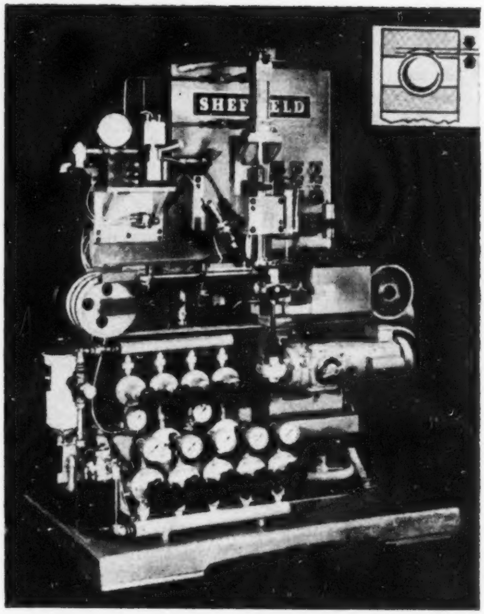


Fig. 2. Sheffield Chekmatic Automatic Inspection Machine for Ball Bearings

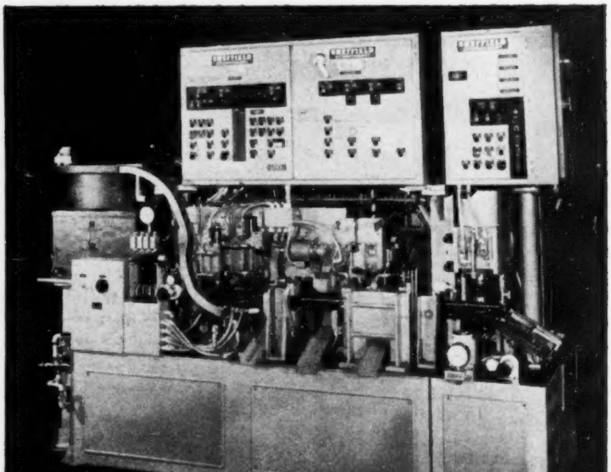


Fig. 1. Sheffield Automatic Assembly and Inspection Machine for Taper Roller Bearings

The Chekmatic gauging unit shown in Fig. 2 is intended for inspecting ball bearings for radial play, the clearance that is checked being indicated by the inset diagram. This machine will handle bearings at the rate of 1,200 per hour, and incorporates adjustable gauging equipment, which enables workpieces in a wide range of sizes to be inspected. Provision is made for automatically sorting the bearings according to the clearance between the balls and races.

Catmur Machine Tool Corporation, Ltd., 103 Lancaster Road, London, W.11, are the selling agents in this country for the Sheffield Corporation.

Methods and Equipment for Checking External Tapers

By C. MINAIRE*

Tapers are extensively employed in the metal-working industries for a variety of purposes, including the location of faceplates and centres on lathes; centralizing and driving drills, milling cutters, and other tools; mounting pulleys; and transmitting power—for example, in cone clutches. If these duties are to be performed satisfactorily, and, in particular, if rigidity and correct centring are to be obtained, it is essential that the tapered surfaces should be produced to close limits of accuracy. Checking of internal tapers is often difficult, due to the limited amount of space that may be available for the introduction of the measuring equipment. External tapers present less difficulty, since all the elements to be checked are normally readily accessible.

Geometrically, the tapers in common use take the form of truncated cones, and inspection operations must verify that: (*a*) the tapered surface is truly conical, (*b*) all sections normal to the axis of the component are circular; (*c*) the angle of taper is correct; and (*d*) the diameters at both ends of the circular portion are within prescribed limits.

CHECKING THE CONICAL SURFACE

The first check in the inspection of a taper should indicate whether the conical surface is really "straight," or is hyperbolic. This latter condition can arise if the tool, or grinding wheel, employed to finish the taper, has not been set in a plane that passes through the axis of rotation of the workpiece.

An indication of the straightness of the taper can readily be obtained by placing the workpiece on a truly plane surface, such as a surface plate, or by holding it in contact with a straight-edge. A much more accurate check is usually necessary, however, and suitable equipment will be discussed later.

CHECKING ROUNDNESS OF SECTION

If there are centre holes at each end of the tapered workpiece, and these holes are in good condition, inspection for roundness can readily be performed by mounting the work between accurate cone-centres, and rotating it on its axis. If there are no centre-holes, or if the holes are in poor condition, the same check can be made by rotating the workpiece in a V-block, longitudinal movement being prevented by a stop at one end.

MEASURING THE ANGLE OF TAPER

(1) *Using gauge blocks and two small rollers.* The workpiece is placed on a flat surface with the small end downwards as indicated in Fig. 1. Two rollers *A*, of the same diameter within very close limits, are located on two gauge blocks *B*, which are of the same height, *h*, also to very close limits. The dimension *d* is then measured. Next, the rollers *A* are placed, as shown at C, on another pair of blocks, which are of the same height, *H*, and the dimension *D* is measured.

From the known and measured values, the included angle (θ deg.) of the taper can then be obtained using the equation:—

$$\tan \theta/2 = (D-d)/2(H-h)$$

If *b* is the diameter of the rollers, the diameter *M*, at a distance *h* from the small end of the taper, is obtained from the equation:—

$$M = d - b\ [1 + \cot (45 - \theta/4)]$$

The diameters of the large and small ends of

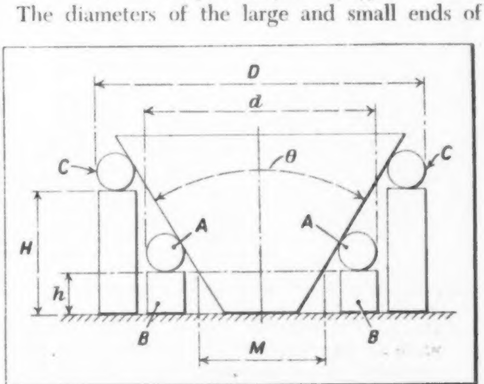


Fig. 1. The Method of Checking a Taper with the Aid of Slip Gauges and Rollers is here Shown Diagrammatically

* Chief of Metrology, National Arms Factory, St. Etienne, France.

the taper can easily be calculated, since they are functions of the distances of the ends from the plane of the diameter M.

(2) *Using two Micyl blocks, L.C.A.* Tapers can be checked with the aid of two special Micyl blocks L.C.A., which have been developed by Laboratoire Central de l'Armement, Paris, and are made by La Précision Mécanique, Paris, represented here by Engineering & Scientific Equipment, Ltd., 38 Minster Road, London, N.W.2. Such a block is shown in Fig. 2, and consists of a parallelepipedal member, with a V-groove accurately parallel to the faces A and B. A half-cylinder C, with a flat datum surface D which passes through its axis, is held in the V-groove by two loops of flexible material as indicated at E. These loops pass over trunnion pins attached to the ends of the block and half-cylinder.

A pair of Micyl blocks is shown diagrammatically in Fig. 3. The two half-cylinders of the blocks can move freely in the V-grooves, and, if the positions of the latter are constant, the distance L between the centres (O, O') of the half-cylinders will not alter, regardless of the angle (a, b, c, d) through which either half-cylinder is turned. In use, the datum faces of the half-cylinders are orientated by the surfaces of a workpiece with which they are brought into contact, as a result of pressure applied by the measuring instrument employed. The dimensions W and h, Fig. 4, are constant for any pair of blocks, and are guaranteed accurate within 0·0005 in.

An application of the Micyl blocks is shown diagrammatically in Fig. 5. The blocks are mounted on slip-gauges to suit the height d of the section to be measured, the height b of the slip-gauge stack being equal to $d-h$. The diameter D at height d is equal to $M-W$. Since the dimension M is independent of the angle ϕ, it is not necessary to know the value of this angle in order to determine the diameter at any given position on the taper. During measurement, pressure is exerted, as indicated at F, and its vertical component is sufficient to hold the Micyl blocks firmly on the slip-gauges.

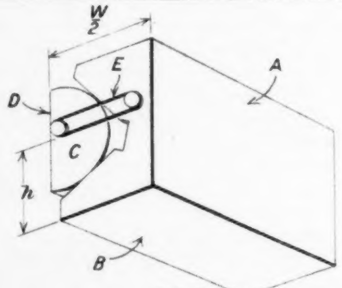


FIG. 2

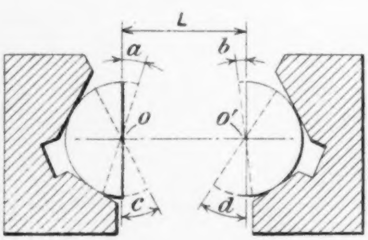


FIG. 3

Fig. 2. A Perspective View of a Micyl Block which has been Specially Developed for Checking Tapers

Fig. 3. The Distance Between the Outside Faces of a Pair of Micyl Blocks is not Influenced by the Angle of the Taper that is Being Checked

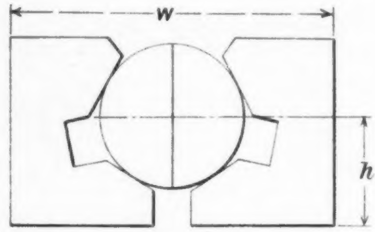


FIG. 4

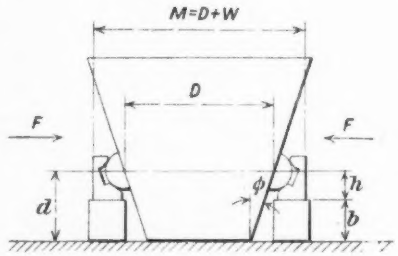


FIG. 5

Fig. 4. The Essential Dimensions of a Pair of Micyl Blocks are Here Shown

Fig. 5. Diagram Showing the Method of Using Micyl Blocks for Checking a Conical Workpiece

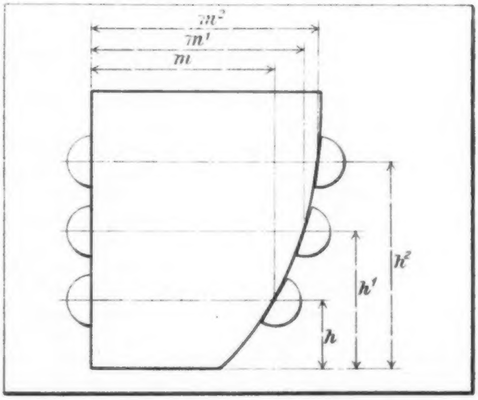


Fig. 6. Micyl Blocks may be Employed for Checking the Ordinate Dimensions of a Curved Form, such as a Cam Plate

The calculations necessary when rollers are employed to measure the diameter at any cross-section of a taper [method (1) above] are eliminated by the application of Micyl blocks. Moreover, the rollers make only point contact with the taper surface, so that there is a possibility of faulty measurements being obtained due to errors in the form or surface condition of the workpiece (that is, micro- or macro-geometric errors.)

Micyl blocks can be used for measuring the outside diameters of truncated cones with included angles of less than 90 deg. In addition, they can be applied, as shown in Fig. 6, to determine the dimensions of parts with convex curved surfaces, provided that the tangent at the measuring position forms an angle of less than 45 deg. with a line normal to the base. They can also be employed for measuring tapered threads, and are frequently applied for checking workpieces or gauges with polygonal contours.

(3) *Using special taper rings.* This method is particularly effective for measuring workpieces with very small angles of taper, and is especially suitable where large quantities are involved, and for checking the taper shanks of tools, such as milling cutters and drills, also lathe centres with Morse, American, or Brown & Sharpe tapers. It can be employed when the workpiece has no centre holes, or when these holes have become worn or damaged.

The two rings, indicated at *A* and *B* in Fig. 7, are made from steel, and after they have been carburized and hardened, are internally ground to the taper required. Diameters *D* and *d* correspond to the diameters at the large and small ends of the taper. The two faces *F*, used for checking the distance between the rings, are ground accurately at right angles to the axes of the bores.

In order to enhance the accuracy of the rings, the bearing surfaces that engage the work are reduced in length by counterboring. The thickness *E* of the rings, is such as to ensure stiffness and stability.

The angle of the taper is checked by measuring the distance between the two rings, when they have been placed on the workpiece. "Go" and "not-go" slip-gauges may be used for measurement, and the sizes of these gauges can be established as follows:—The rings are mounted on a master taper gauge and the distance *M* between them is measuerd. An axial dimension equivalent to the tolerance permitted on the taper is calculated, and is added or subtracted to the value of *M*, depending on the way in which the tolerance is expressed, to give the thicknesses of the slip-gauges.

In use, the rings *A* and *B* are applied to the large and small ends of the taper. The distance between the datum faces *F* of the rings is then checked with the "go" and "not-go" slip-gauges. If the "not-go" gauge can be inserted, the angle is too small, and if the "go" gauge will not enter, the angle is too large.

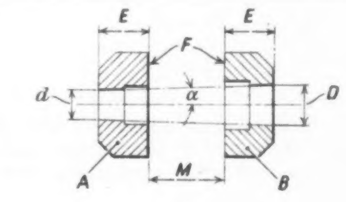


FIG.7

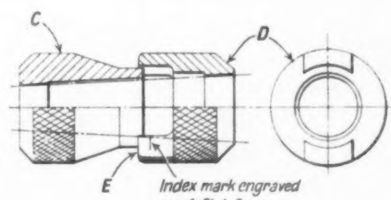


FIG.8

Fig. 7. Special Ring Gauges can be Effectively Employed for Checking Tapers

Fig. 8. A Taper Gauge of this Design, Incorporating Two Ring Gauges, may be Applied for Checking After Rough Machining

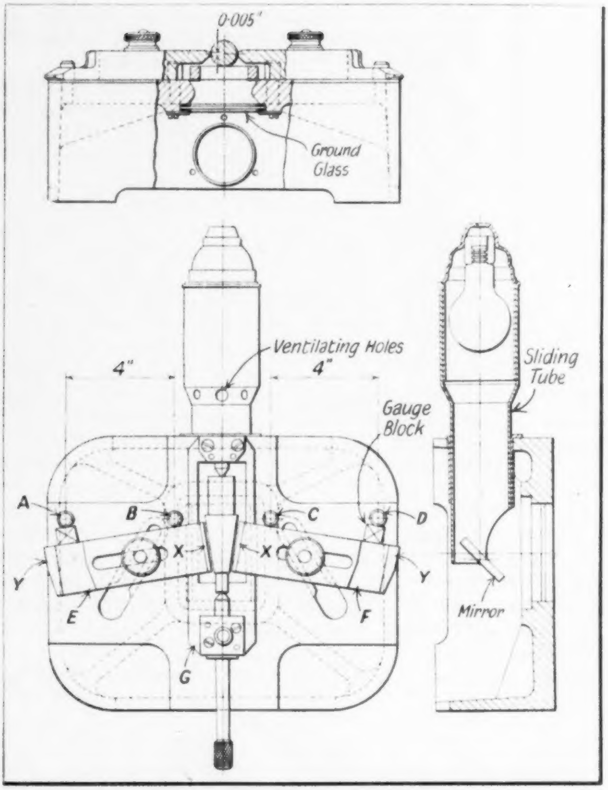


Fig. 9. In this Gauging Equipment, Based on the Sine Bar Principle, the Workpiece is Mounted above a Source of Diffused Light, and Brought into Contact with Straightedges

In Fig. 8 is shown another type of gauge that is similar in principle to the checking rings in Fig. 7. This gauge may be employed with advantage when the taper has a fairly wide tolerance, or for checking a workpiece after a roughing operation. It consists of two rings *C* and *D*, each with a ground tapered hole and a counterbore. The distance between them is checked, not by means of slip-gauges, but by observing the position of the end of the ring *C* relative to an index mark on the ring *D*, and the end face *E* of the latter member. The gauge is much quicker to use than the type shown in Fig. 7, and is accurate enough for checking after rough machining.

The two rings are applied to the opposite ends of the workpiece. If the end of the ring *C* lies between the end face *E* and the index mark on the ring *D*, the spacing of the rings is within the limits corresponding to the tolerance on the taper. If the end of the ring *C* is on the left of the end face *E*, the angle is too small; if it is on the right of the index mark, the angle of the taper is too large.

(4) *Methods based on the measurement of the sine of the taper angle.* Checking equipment will now be described which enables the sine of the taper angle to be measured. The equipment shown in Fig. 9 has been developed for measuring the angles of tapers—up to a maximum angle of 90 deg.—and checking the straightness of the flanks, to a very high degree of accuracy. It consists of a flat cast-iron surface plate on which are mounted four tungsten carbide cylinders *A*, *B*, *C*, *D*. These cylinders are of the same diameter within very close limits, and are very carefully aligned. To simplify the calculations involved, the centre distance between *A* and *B*, and *C* and *D* should be made an even number of inches (for example, 4 in. in Fig. 9).

The tapered workpiece to be checked is held between one moving and one fixed centre, mounted on a movable member *G*, so that it is supported above a luminous screen. This screen consists of a sheet of ground glass, tinted green, and is illuminated by an electric lamp. In order to reduce the transfer of heat from the bulb to the surface plate, which might give rise to local deformation, and thus reduce the accuracy of measurement, the lamp is mounted in a housing remote from the plate, and the light is reflected by a movable mirror.

Two contact fingers *E* and *F* are adjustably mounted on the surface plate. These fingers are made from steel, and are carburized, hardened, and chromium plated, before being carefully ground and stabilized. The edges indicated at *X* and *Y* are employed for gauging, and are finished accurately at 90 deg. to the long sides of the fingers. These gauging edges are chamfered to leave a land about 0·005 in. wide, equispaced about the axis of the centres as indicated in the upper view. The surface of each upper chamfer has a matte finish to eliminate reflections.

In use, the fingers *E* and *F* are set at a sufficient distance apart to enable the workpiece to be inserted between their gauging edges. At one

end, the fingers bear directly on the cylinders *B* and *C*, but their other ends rest against slip-gauges which contact the cylinders *A* and *D*. The thickness of the slip gauges is equal to the sine of the angle to be measured, multiplied by the distance between the cylinders on one side of the unit (in this instance 4 in.). The tapered workpiece, supported between the centres on the member *G*, is brought into contact with the finger *E*, so that the narrowest possible line of light is produced. If this line is of uniform width, it indicates that the taper is straight.

If the angle of taper is correct, there will be a similar line of light between the workpiece and the edge of the finger *F*. Should the angle not be correct, however, the light line will be wedge-shaped. By reducing or increasing the thickness of the gauge blocks until both light lines are parallel, the actual angle of taper on the workpiece can readily be determined.

If it is not feasible to ensure that cylinders of exactly the same size are positioned at a precise distance apart, nor that the measuring edges of the fingers *E* and *F* are exactly at 90 deg. to their long sides, a correction factor can be established by means of a cylindrical or tapered master mounted in the centres, and located between the fingers. This factor can then be applied when workpieces with close tolerance are being checked. The smallest line of light that can be seen with the naked eye is about 0·0001 in. wide, so that the accuracy of measurement with this equipment is about 6 sec. on the half-angle of a taper 2 in. long. Measurements to closer limits of accuracy can be obtained by observing the light-line with a microscope.

When equipment of the type described is not available, or when the workpiece has no centre holes, the arrangement shown diagrammatically in Fig. 10 can be effectively employed. A V-block is used, the groove-angle of which has been accurately determined. The workpiece is mounted in the groove and the block is placed on a sine table. The angle a between the base of the block and the upper surface of the taper is then determined by adjusting the slip gauge stack under the free cylinder of the table until the upper surface of the taper is parallel to the table base. An indication of the straightness of the taper is afforded by checking the upper surface (ND) for equidistance from the base.

The angle a, Fig. 10, can readily be determined since $\sin a = H/L$, H being the height of the slip-gauge stack and L the distance between the axes of the table cylinders. From the angle a, the half-angle b of the taper can be established by using the graphical construction shown in Fig. 10. The line XF is drawn through the point X and perpendicular to the base PN. A circle is drawn with centre X and radius XE (which is equal to XD) and the line DP is drawn perpendicular to DN, and passing through the point X. The angle PXF is then equal to the angle a because its sides XP and XF are at right angles to DN and PN respectively. The angle c is half the included angle of the V-groove.

Then, $DN = DP.\cot a = (XD + XP).\cot a$

$PX = XF.\sec a = XE$ or $XD.\operatorname{cosec} c.\sec a.$

Thus, $DN = (XD + XD.\operatorname{cosec} c.\sec a)\cot a.$

On the other hand, $DN = XD.\cot b.$

Therefore, $XD \cot b = (XD + XD \operatorname{cosec} c.\sec a) \cot a.$

Dividing both sides of the equation by XD, we have:

$$\cot b = (1 + \operatorname{cosec} c.\sec a)\cot a$$
$$= \cot a + \operatorname{cosec} c\,(\sec a.\cot a)$$

But, $\sec a.\cot a = 1/\cos a \times \cos a/\sin a$
$$= 1/\sin a = \operatorname{cosec} a.$$

Finally, $\cot b = \cot a + \operatorname{cosec} c.\operatorname{cosec} a$

In most cases, where the angle c has a value of 45 deg., $\cot b = \cot a + \sqrt{2}\operatorname{cosec} a.$

If the angle b is known, the height H can be

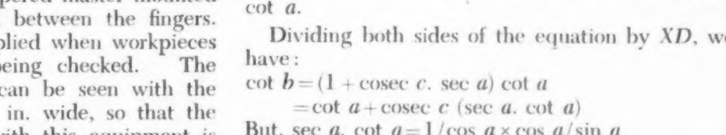


Fig. 10. Tapers Can be Checked for Angle with the Aid of a V-block Mounted on a Sine Table

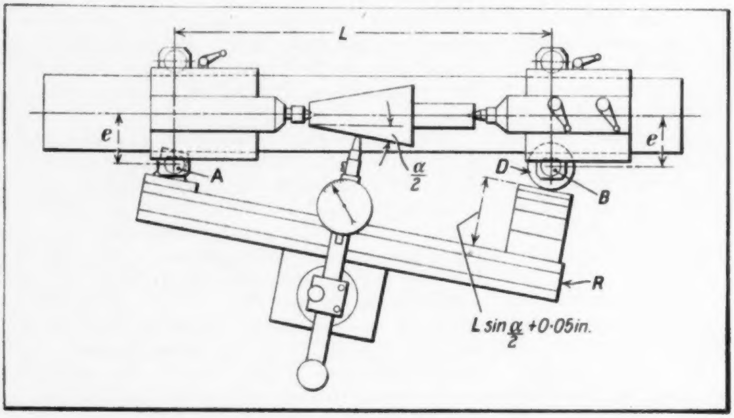


Fig. 11. A Pair of Bench Centres, Modified for Checking Angle of Taper of Included Angle α deg.

determined, from the expression $\sin a = H/L$, by first finding the angle a, as follows:

$\sin (a\text{-}b) = XF/XN = XE$ or XD. $\operatorname{cosec} c/XN$

but $XN = XD/\sin b$, so that

$\sin (a\text{-}b) = XD \operatorname{cosec} c.\ \sin b/XD = \operatorname{cosec} c.\ \sin b$.

When the angle $c = 45$ deg.

$$\sin (a\text{-}b) = \sqrt{2} \sin b.$$

Since $(a\text{-}b)$ and b are known, the value of a can be found from the expression $(a\text{-}b) + b = a$.

Taper-angle, roundness of cross-section, and straightness of the sides of a taper, can be checked at one setting of the work, by means of the set-up shown in Fig. 11.

The workpiece is mounted between the centre-points of a set of bench centres. One pair of bolting-down holes A and B has been carefully re-machined and reamed, so that they are at the same distance (e) from the axis of the centres within close limits, and their centre distance L is carefully measured. A pin attached to a straightedge R is located in the hole A. The straightedge is free to swing about the axis of the hole A, through an angle which may range from 0 to 45 deg. with the axis of the centres, and its datum edge was carefully trued.

A disc D is mounted co-axial with the hole B, by means of an integral spigot. Slip gauges are located between the disc D and the straightedge R to set the latter member at the required angle. The diameter of the disc is such that the outer face of the straightedge is parallel to the axis of the centres, when the height of the slip-gauges is 0·05 in. This value of 0·05 in. was selected to permit of checking very small angles. The height (H) of the slip gauges to set the straightedge at any angle of $\alpha/2$ is given by the expression

$$H = L \sin \alpha/2 + 0{\cdot}05 \text{ in.}$$

With the modified bench centres mounted on a surface plate, and the work held between the centre points, the straightedge is set to the required angle ($\alpha/2$). A dial indicator gauge is mounted on a support, the base of which is located against the outside edge of the straightedge. The anvil of the gauge is adjusted so that it is at 90 deg. to the straightedge and is lying in a horizontal plane that passes through the axis of the centres. By sliding the base along the straightedge, with the anvil in contact with the tapered surface of the workpiece over its full length, any errors in straightness or taper-angle are indicated. By rotating the workpiece, any non-circularity of section can readily be detected.

Taper reamers and milling cutters with helical

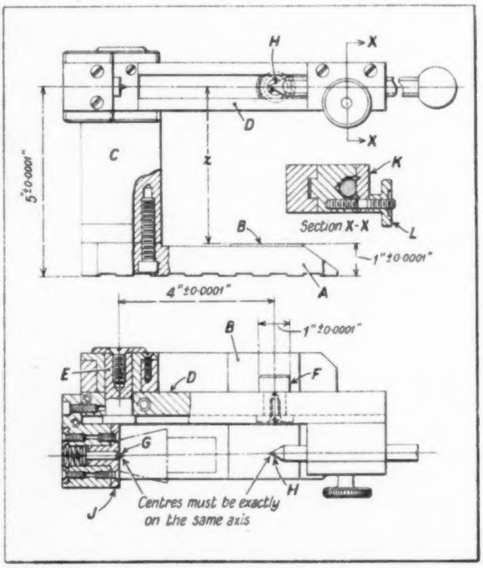


Fig. 12. This Special Test Stand Provides for Measuring Angle of Taper. The Work-carrying Member has a Pair of Centres, and can be Adjusted for Angle with the Aid of Slip Gauges

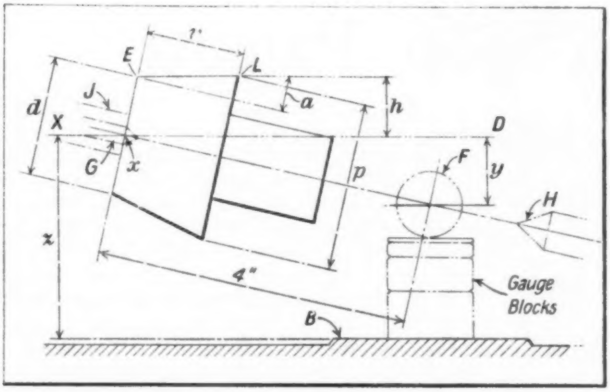


Fig. 13. The Method of Operation of the Equipment Shown in Fig. 12 is Here Illustrated Diagrammatically

teeth can readily be checked with the equipment and procedure that have just been described. After the straightedge has been set at the required angle, readings are taken at the large and small ends of the tool. The tool is rotated on its axis during these checks, and if the angle of the tool is correct, the maximum reading at each end will be the same. It will be clear that the equipment can also be used for checking a cylindrical workpiece for straightness and parallelism by setting the straightedge parallel to the work-axis by means of a 0·05-in. slip gauge.

The equipment shown in Fig. 12 provides for checking any workpiece with the form of a truncated cone, for angle, straightness of side, roundness of cross-section normal to the axis, and end diameter. A plate *A*, with the base and platen *B* accurately flat and parallel, carries a pillar *C*. The centre support *D* can swing through 45 deg., above and below the horizontal, about a pivot pin *E*, which is at a height z above the platen. Secured to the centre support *D* is a disc *F* of 1 in. diameter, and the centre of the disc is set accurately at a known distance from the pivot pin *E*, in this instance 4 in. The centre of the disc is also located accurately in the same plane as the axes of the pivot pin and the centres *G* and *H*.

By placing a stack of slip gauges between the disc *F* and the platen *B*, the centre support *D* can be set accurately at any angle a, and the height of the slip gauge stack is given by the expression $z-(4 \sin a+0{\cdot}5)$ in.

A workpiece to be checked is held between the centres *G* and *H*, with its small end in contact with the face of the bushing *J*. This face is arranged to coincide exactly with the axis of the pivot pin *E*. The centre *G* is spring loaded, whereas the centre *H* can be adjusted lengthwise, and is clamped in position by the plate *K* and the screw *L* (section *X—X*).

From the diagram Fig. 13 it will be seen that when a workpiece is mounted between the centres of the equipment, its axis and small end face, also the axis of the pivot pin, coincide at the point x. The upper surface (indicated by *EL*) of the conical portion of the workpiece is set parallel to the base of the equipment by locating the centre of the disc *F* at a distance y from the plane *XD*. It is known that $\sin a = y/4$, so that the angle a can readily be determined. The height h of the surface *EL* from the point *X* can be found by measuring the height of the surface from the platen *B* and then subtracting the value z. The diameter of the small end (d) is equal to $h \sec a$, and by measuring the length c, the diameter of the large end (p) can be found from the expression $p = d + 2c.\tan a$.

Roundness of the workpiece at various positions along its length can be checked by placing the stylus of a dial indicator in contact with the surface *EL*, and rotating the workpiece on its axis. Straightness of the conical portion of the workpiece can be verified by checking that the surface *EL* is equidistant from the base of the equipment throughout its length.

PLANNED MAINTENANCE.—Mr. C. E. Sutton, Jr., of the General Electric Co., U.S.A., speaking recently before the American Society of Mechanical Engineers, said: "Industry must realize that the more rapidly it progresses toward automation, the more it spends for larger, finer and more elaborate tools, the more urgent and necessary becomes a planned productive maintenance programme to ensure that profits will be returned from the investment in facilities and equipment. The days are gone forever when a good all-round mechanic can be the maintenance boss."

He went on to forecast that the maintenance engineer would manage the largest direct labour force in the highly mechanized plant of the future. It was necessary, therefore, for top management to be convinced that the man responsible for maintenance should be up-graded from the shop foreman level to a position on the management team along with engineering, purchasing, manufacturing, and marketing.

Machine Shop Patents

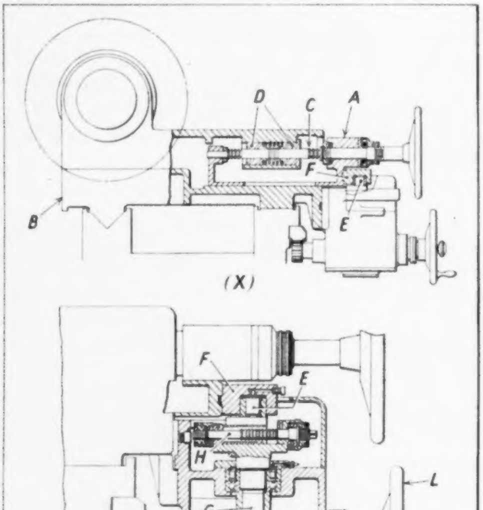
A CAMBER GRINDING MACHINE FOR ROLLS

Two sectional views of the grinding head control mechanism of a machine for producing rolls with concave or convex camber are shown at *X* and *Y* in the figure. A transverse slide *A*, carrying the grinding head, is mounted on a sliding saddle *B*, which can be traversed along the machine bed by means of a lead screw, not shown. Transverse feed motion can be applied to the grinding head by the screw *C* and the nut *D*, seen in the view at *X*, the nut being designed to take up all backlash. The slide *A*, can be moved transversely, as a complete unit, by the eccentric pin *E*, which engages the block *F* attached to the outer end of the saddle *B*. This pin is carried on a V-slide in the upper end of the shaft *G* (view *Y*) and the amount of eccentricity between these two parts can be adjusted by the screw and nut at *H*.

At the lower end of the shaft *G* there is a worm-wheel, and the mating worm is driven by the rotation of the pinion *K*, as it is traversed along a rack attached to the machine bed. The ratio of the worm and wheel is such that one complete traverse of the pinion *K* along the rack will impart 180 deg. of angular movement to the shaft *G*. A dog clutch enables the pinion *K* to be disengaged from the worm, and the latter can then be rotated by means of the handwheel *L*.

The amount of eccentricity between the shaft *G* and the pin *E* is adjusted to suit the extent of camber required on the roll, and if the pin *E* is set so that it is coaxial with the shaft *G*, parallel rolls may be ground.

786,756. Dronsfield Brothers Ltd., Atlas Works, King Street, Oldham, Lancs. *[Application date February 18, 1955. Published November 27, 1957.]*



Grinding Head Control Mechanism for Camber Grinding Machine

New Jet Piercing Process for Rock Drilling

A jet-piercing process for rock-drilling, which has been developed by the Linde Department, Union Carbide International Co., Division of Union Carbide Corporation, U.S.A., is claimed to offer important advantages. It is being used, for example, in connection with the St. Lawrence Seaway project, and it is stated that blast holes can be produced at speeds up to 10 times as great as are possible with conventional drilling.

In this piercing process, low viscosity fuel oil or paraffin is burned with high-purity oxygen in a rocket-type burner, which is mounted on a converted churn drilling unit. This unit moves on caterpillar tracks, and the piercing rig can readily be raised and lowered. Flame temperatures up to 4,000 deg. F., and velocities of the order of five times the speed of sound, are obtained.

This flame rapidly disintegrates rock, including those types which present great difficulties with normal drilling. At maximum velocity, a flame not more than 18 in. long by 2 in. wide has a mechanical energy equivalent to about 500 h.p. It is reported that whereas the drilling of a 100-ft. deep hole in certain rock formerly occupied a week, the operation can now be completed in one shift.

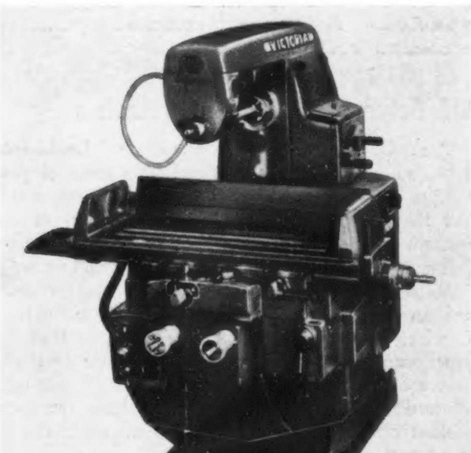
Chambering of the holes produced can be carried out by withdrawing the blow-pipe from the bottom of the holes, and allowing the flame to produce a bottle-shaped cavity.

New Production Equipment

Victomatic 0-18 in. Production Milling Machine

B. Elliott & Co., Ltd., Victoria Works, Willesden, London, N.W.10, have recently introduced the Victomatic 0-18 in. knee-type production milling machine shown in the figure.

The 36- by 10⅝-in. T-slotted table has a longitudinal travel of 18 in., and 16 feeds, which may range from 0·6 to 16 or from 1·3 to 32 in. per min., can be obtained by change gears. Drive for the feed movement is taken from a ¾-h.p. motor. The saddle has a cross adjustment of 7 in., and the knee a vertical movement of 14¾ in. by hand. A maximum distance of 15 in. is obtainable between the spindle axis and the working surface of the table, and there is a 5¾-in. clearance between the spindle and the box section overarm. Twelve spindle speeds ranging from 45 to 1,215 r.p.m. are provided, the drive being taken from a 2½-h.p. motor through V-belts. An electro-magnetic spindle brake can be fitted.



Victomatic 0-18 in. Production Milling Machine

By means of a rotary switch on the knee, the machine can be set for continuous pendulum milling, or for single automatic cycle operation, with power feed movement of the table in either direction. Rapid power traverse at the rate of 150 in. per min. is automatically engaged during any non-cutting portions of a cycle, by means of stops adjustably mounted on the front of the table. A backlash eliminator is provided, which enables climb milling to be performed with both right- and left-hand cutters, and is automatically disengaged upon reversal of the table. The eliminator can also be disengaged by movement of a lever when conventional milling is to be performed.

Other rotary switches enable the spindle to be driven continuously during the working cycle, or only when power feed is applied to the table. Since the power feed and spindle drives are taken from separate motors, they can be engaged independently.

The machine occupies a floor space of 72 by 60 in., and weighs approximately 1 ton 5 cwt.

Pongracz Simplomat Single Spindle Automatic Screw Machine

The accompanying Fig. 1 shows the Simplomat P26 single spindle, automatic screw machine, which has been developed by Friedrich Pongracz, Vienna, and is marketed in this country by F. J. Robotham & Co., Ltd., 71 Lascelles Road, Slough, Bucks. This machine was demonstrated at the recent Machine Tool Exhibition at Hanover, and is made in three sizes of 12-mm., 18-mm., and 26-mm. bar capacity, which are known as the P12, P18 and P26, respectively. The capacity of the latter can be increased to 30 mm. by fitting an outside feeding attachment. Each machine has a 3-h.p. spindle motor, and six spindle speeds, the ranges being: 1,200 to 6,000 r.p.m.; 900 to 4,500 r.p.m., and 600 to 3,000 r.p.m. Steplessly variable camshaft speeds can be provided. Alternatively, a gear box may be fitted, which enables 16 different cam-

shaft speeds to be obtained. When the machine is to be used for long production runs, on a very limited range of components, it can be supplied with only one or two camshaft speeds.

Standard machines have two forming slides and one end-working slide, but a third forming slide may be added, as can be seen in the close-up view in Fig. 2. The bar is advanced through the collet by a feed finger, and the maximum feed-out is 70 mm. (2¾ in.) on all three machines. Maximum drilling capacities of the machines are 10, 15 and 20 mm. diameter.

Other additional equipment which can be fitted includes a three-tool drilling attachment, and, in the case of the P18 and P26 machines only, a rapid traverse attachment for reducing the idle time. In addition, there is a longitudinal turning attachment, and various types of thread-cutting equipment. The attachment enables lengths up to 2¾ in. to be turned, and incorporates a patented compensating arrangement which prevents cross movement of the tool slide, due to any irregularities on the dwell portion of the cam profile, while turning is actually in progress. Micrometer adjustment is provided which enables different cross travels of the tool slide to be accurately set, independently, irrespective of any inaccuracies in the cam profile, when stepped parts with two or three diameters are to be turned.

By using a pole-changing motor, 12 spindle speeds can be obtained, within the ranges previously mentioned, and an automatic cut-out can be fitted, which operates when the stock is exhausted. A patented overload protection mechanism is also available.

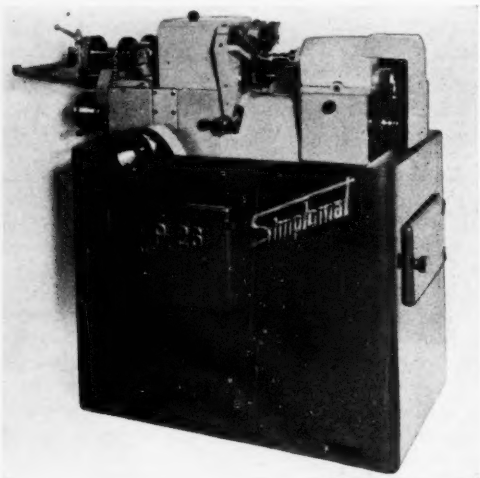


Fig. 1. Pongracz Simplomat Single-spindle Automatic Screw Machine

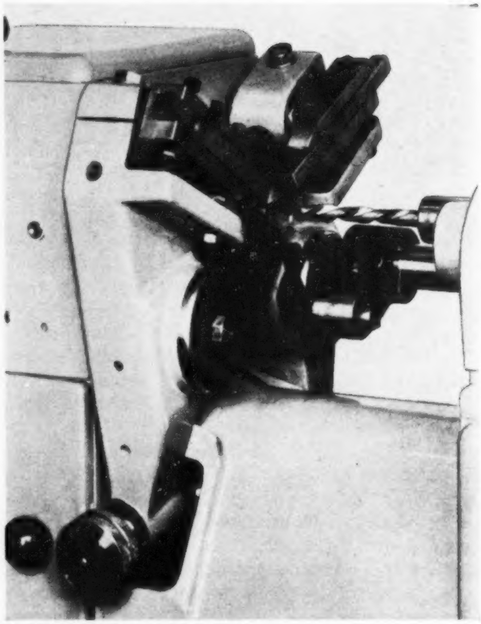


Fig. 2. Close-up View of the Forming and Drilling Slides on the Simplomat Automatic Screw Machine Shown in Fig. 1

VDF Polycop Copy Turning Lathes

The German Group Vereinigte Drehbank-Fabriken have now introduced two sizes of production copy turning lathes known as the Polycop I, and Polycop III, the latter being shown in the accompanying illustration. Of completely new design, these lathes incorporate the Group's well-established electronic-hydraulic copying system, and are noteworthy for their robust construction. The bed-ways are arranged vertically, so that the swarf can fall freely, and the machine bed and base are cast in one piece. Coolant and hydraulic oil tanks are incorporated in the base, and the coolant circulation is arranged to maintain the oil at a constant low temperature.

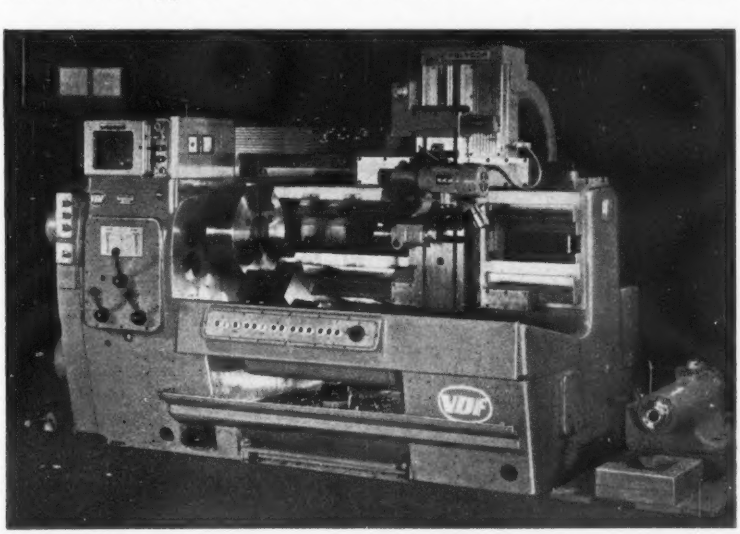
Both longitudinal and transverse copying can be carried out, and a swivel-type lower support, with automatic feed, is provided, whereon grooving, facing, and other types of tools can be mounted,

for performing in-feed operations at any position along the workpiece. The vertically-disposed cross slide has a long clamping surface for the reception of a longitudinal turning tool, or several tool-holders for performing transverse copying operations under the control of a series of templates. Alternatively, an indexing 3-way tool turret and template carrier can be fitted, as shown in the illustration, for a sequence of operations. The machine can be set to operate on a completely automatic cycle, which includes changes of speeds and feeds, and either a manually- or an electrically-operated tailstock can be fitted, the latter enabling a pre-set axial pressure from 220 to 2,600 lb. to be applied.

On the Polycop I lathe, the maximum turning diameter over the bed is 14 in., and over the cross slide, $6\frac{5}{16}$ in. The copying traverse of the carriage is $39\frac{1}{2}$ in., and of the cross slide $7\frac{3}{32}$ in., and the feed rates are steplessly variable up to 0·040 in. per rev. Drive to the headstock is taken from a motor of 20 h.p., and there are 15 spindle speeds from 71 to 1,800 r.p.m.

The Polycop III lathe has a maximum turning capacity of $22\frac{1}{16}$ in. diameter over the bed, and $10\frac{5}{8}$ in. diameter over the cross slide, and the longitudinal and transverse copying strokes are $39\frac{1}{2}$ in. and $11\frac{1}{32}$ in. Twelve spindle speeds from 90 to 1,120 r.p.m. are available, and the drive is taken from a motor of 36 h.p. If desired, a steplessly-variable drive can be provided to the headstock of either type of lathe, to enable a constant cutting speed to be used for transverse copying.

Sykes Machine Tool Co., Ltd., Manor Works, Staines, Middlesex, are the sole agents in this country for VDF lathes.



VDF Polycop III Copy Turning Lathe

"Cross" Transfer-matic Transfer Machine for Rear Axle Differential Gear Housings

Shown in the illustration is a Transfer-matic automatic transfer machine built by the Cross Company, Detroit, Michigan, U.S.A., for performing a number of operations on single-piece rear-axle differential gear housings for motor vehicles. A cut-away view of a workpiece is shown inset.

Two components at a time are handled on the machine, and the operations comprise, rough- and finish-forming two spherical seatings for pinions; rough- and finish-boring, and facing two seatings for side gears; drilling, boring and reaming a pinion shaft hole; drilling and reaming a locking-pin hole; and drilling, chamfering spot-facing and reaming 12 holes for the crown wheel mounting. Housings are handled at the rate of 212 per hour when the machine is operating at 100 per cent efficiency.

The workpieces are located on pallet-type fixtures by the seatings for the crown wheels and one of the end journals, which have been turned and ground at previous operations. Movement of the fixtures from one station to the next is effected by two reciprocating transfer bars. At the end of each transfer stroke, the pallets are raised clear of the bars, and are brought into engagement with locating pins and pads attached to bridge members. The fixtures are then held securely in the working position during the cutting cycle, by wedges. Spindle heads for performing internal boring and facing operations are carried by the bridge members, and the cutters are passed through openings in the workpiece. Since all the operations are performed at a single setting of the workpieces on the fixtures, the relationships between the various machined surfaces are held to close tolerances.

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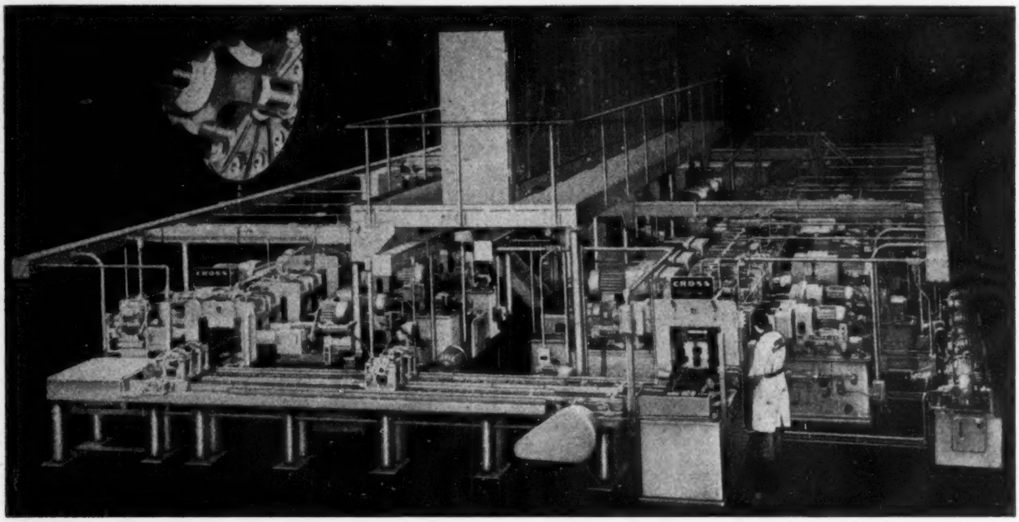
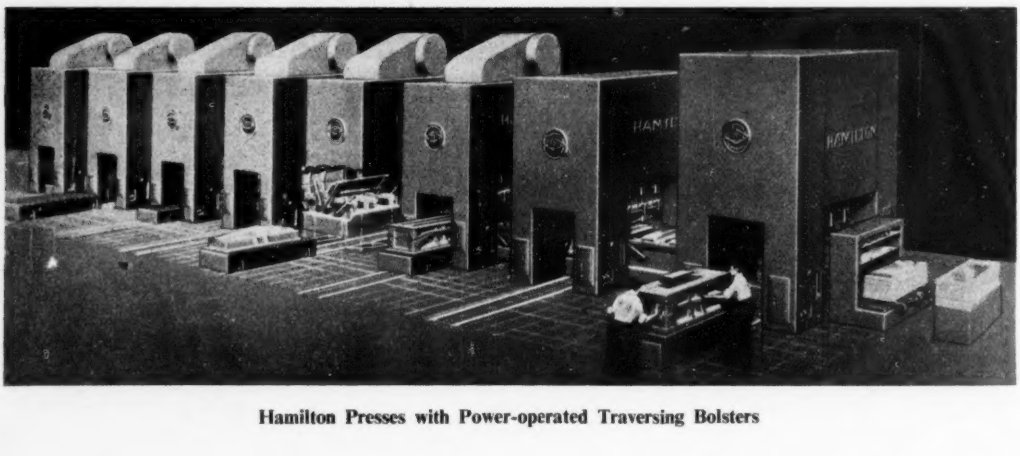


"Cross" Transfer-matic Transfer Machine for Rear Axle Differential Gear Housings

All guideways on the machine are of steel, hardened and ground, and an automatic lubrication system is provided. Pre-set cutting tools are employed, and the company's programme control system for tool changing is incorporated.

Hamilton Presses with Power-operated Traversing Bolsters

Particularly intended for producing parts in small batches, the presses here illustrated, which were built by the Hamilton Division, Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio, U.S.A., have two bolsters to accommodate separate dies. The bolsters are traversed under power, on ways in the shop floor, through openings in the sides of the press frames, as shown. Alternatively, they can be arranged to pass through openings in the fronts and backs of presses. With this system, while components are being produced with the tool on one bolster, another punch and die can be mounted on the other bolster, and subsequently brought into use rapidly when required.



Hamilton Presses with Power-operated Traversing Bolsters

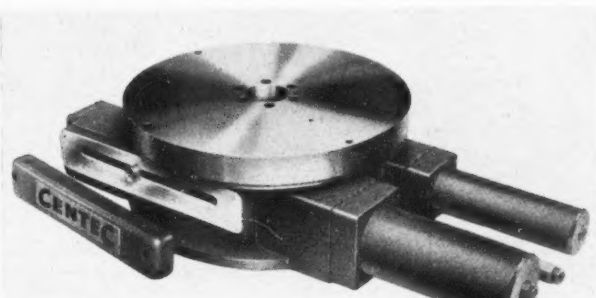
It is stated that a period of only 5 min. need elapse between the end of one production run and the start of the next, with different tools. About ½ hr. is required for changing tools on the outer bolster, which, for this purpose, is brought completely clear of the press frame to afford free access for an overhead crane. When loading of the new tools has been completed, the bolster is traversed inwards to a position adjacent to the one in use, so that the floor space requirements are reduced.

The bolsters, which are available for single- and double-acting 2-, 3-, and 4-point presses, of both over- and under-driven designs, can be moved independently, or simultaneously, by a push-button controlled motor drive in the base of the press. They can also be traversed by means of motor-driven winches.

Centec 16-in. Automatic Air-operated Indexing Table

Centec Machine Tools, Ltd. (formerly Central Tool & Equipment Co., Ltd.), Centec Works, Hemel Hempstead, Herts., have recently introduced the automatic, air-operated, indexing table, here shown.

A feature of the design is that 60 different angular movements of the 16-in. diameter work table can be obtained, without the need for changing index plates, by setting a knob in a horizontal slot in the base with reference to a scale. Indexing is carried out to an accuracy of a few seconds of arc, and the cycle is started by means of an impulse valve which can be arranged for hand, foot or cam operation. Upon completion of the table movement, the indexing mechanism is automatically re-set in readiness for the next working cycle. The table speed can be varied steplessly by means of an adjustable hydraulic dashpot.

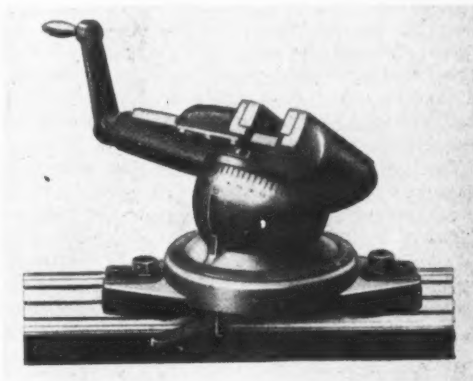


Centec 16-in. Automatic Air-operated Indexing Table

Work plates up to 30-in. diameter may be mounted on the table, which has a central 2-in. diameter bore. Weighing 300 lb., the unit occupies a space of 36 by 16 in., and has an overall height of 7⅜ in.

R.I.D. Machine Vice and Universal Swivel Base Unit

Trend Industrial Equipment, Ltd., 5 The Ridgeway, Stanmore, Middlesex, are the sole agents in this country for the Swiss-made R.I.D. machine vice and universal swivel base unit here illustrated.



R.I.D. Machine Vice and Universal Swivel Base Unit

The vice is mounted centrally on the plane surface of a semi-spherical supporting member, and the latter is carried, in turn, in a part-spherical recess in the centre piece of the base. This supporting member can be swivelled in the horizontal plane through an angle of 360 deg., and locked in the required position by a lever, positive location being provided at 15-deg. intervals by means of a spring-loaded dowel. In addition, the vice and supporting member can be tilted in the vertical plane, as shown, through a maximum angle of 15 deg. With this arrangement, the work can quickly be set in a variety of angular positions in relation to

the cutter, without the need for using fixtures or packing pieces.

Rectangular and circular T-slotted work tables are available, which can be mounted on the unit in place of the vice. A swivel base without provision for tilting can also be supplied.

The equipment is made in two sizes, with vice jaw openings of 3½ and 5¼ in.

Fosdick Fosmatic Tape-controlled Jig Boring Machine

Fosdick Machine Tool Co., Cincinnati, Ohio, U.S.A., have introduced the Fosmatic tape-controlled jig boring machine shown in Fig. 1. The tape is prepared direct from information on the part drawing, by means of a "decimal tape" punch which obviates the need for coding, and it is stated that table settings are made to an accuracy of $\pm 0{\cdot}0001$ in. A push-button is depressed to start the work cycle, and both spindle speed and feed are then set automatically.

The measuring system incorporates gauges to class A designation, which are disposed along X and Y co-ordinates and enable distances in increments of 0·0001 in. to be obtained. Gauges for the required setting are selected by means of motor-driven drum dials, and movement of the table serves to "stack" the gauges and causes them to operate a switching mechanism. On reaching the selected position, the table is stopped, the traversing screw is relieved of its load by a slight reversing movement, and the table clamps are applied. Fig. 2 is a close-up view of part of the setting equipment, and shows the drum dials.

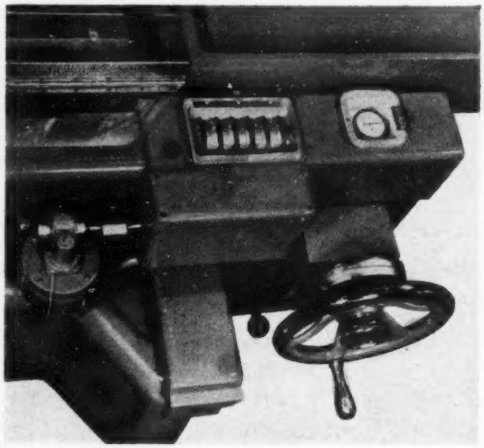


Fig. 2. Motor-driven Drum Dials on the Fosdick Tape-controlled Jig Boring Machine

The machine has 16 speeds from 30 to 1,800 r.p.m. which are controlled by electro-magnetic clutches, and there are eight feed rates ranging from 0·0005 to 0·010 in. per min. A maximum height of 27½ in. is admitted between the spindle and the 54- by 22-in. table.

Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London, S.W.11, are the agents in this country for the Fosdick Machine Tool Co.

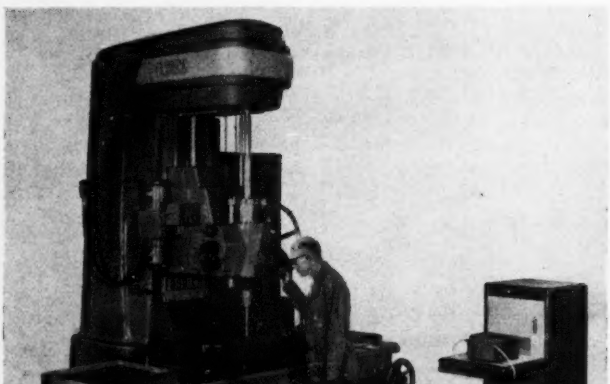
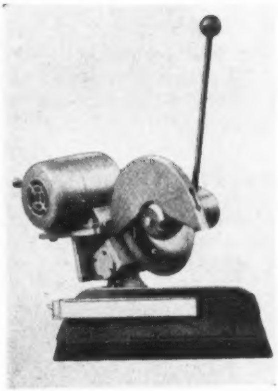


Fig. 1. Fosdick Fosmatic Tape-controlled Jig Boring Machine

Eisele Cutting-off Machine

Addison Tools Co., Ltd., 10 Old Street, London, E.C.1, are the selling agents in this country for the German-made Eisele type LMS 57 cutting-off machine shown in the accompanying figure.

This bench-mounted machine is particularly intended for cutting sections of various shapes, in non-ferrous metals, which can be enclosed by a circle of 3 in. diameter. Drive to the pivoted saw-head is taken from a pole-changing motor, and spindle



Eisele Cutting-off Machine

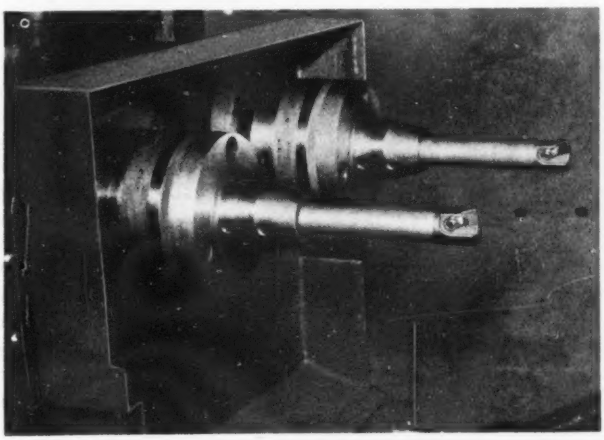
speeds of 2,000 r.p.m. for cutting light alloy and 1,000 r.p.m. for copper and brass sections are obtainable. High-speed steel saws of 10 in. diameter by 0·08 in. wide can be supplied with teeth of either standard or coarse pitch, the former being intended for cutting sections and tubing with wall thicknesses up to 3/16 in. Sections and tubing with thicker walls, and solid bars up to 3 in. diameter may be cut with the coarse-pitch saw. The entire saw head can be swivelled in the horizontal plane up to 45 deg. to the left and 60 deg. to the right, for taking angular cuts. A slitting attachment is available which enables burr-free right-angle cuts to be taken in metal plates, angles, and sections.

Carbide-encased Boring Bars

Experiments with boring bars which are encased with carbide, and fitted with throw-away carbide tips, have been carried out by Kennametal Inc., Latrobe, Pa., U.S.A. As a result of these investigations it has been found that bars strengthened in this manner can be used for applications which have hitherto required pilot steadies. It is claimed that these bars are virtually free from chatter, and that they enable tooling costs and machining times to be considerably reduced.

The accompanying illustration shows a pair of Kennametal encased boring bars, employed on a Heald Borematic, for boring two 1·000-in. diameter bolt holes in the connecting rod and cap of a large diesel engine. Limits of +0·001 −0·000 in. on the diameter are specified for these holes, and when piloted boring bars were used, difficulty was encountered in maintaining this accuracy. Furthermore, excessive tool breakage and wear of the bar were experienced. It is reported that when these holes were snout-bored with Kennametal encased bars, the dimensional tolerance was held, and tool costs reduced to one-sixth of that incurred with the previous method. The tests also appear to indicate that if the core of a carbide-encased bar is of a fairly soft material, the cutting performance of the tool is increased and chatter is further reduced.

In the application already mentioned, Kendex K8 carbide tips were used for semi-finish boring, with a spindle speed of 950 r.p.m. and a table feed rate of 2 in. per min. For finish-boring, the spindle speed was increased to 1,100 r.p.m. and the feed rate to 3½ in. per min. These tool tips are mechanically clamped, and when they are indexed the positional accuracy is within 0·002 in. As the boring bars were mounted in heads which incorporated an adjustment of 0·012 in. on either side of centre, a fresh edge could readily be selected, and set.



Carbide-encased Boring Bars Set-up on a Heald Borematic Machine for Boring Bolt Holes in the Cap and Connecting Rod of a Large Diesel Engine

Kennametal encased boring bars are being made in a wide range of diameters and lengths, and tests are proceeding on a carbide-encased bar of 1¾ in. diameter by 14 in. long. Kennametal carbide tools are marketed in this country by Geo. H. Alexander Machinery, Ltd., Guns Lane, West Bromwich, Staffs.

Barson Type LTSa Abrasive-wheel Cutting-off Machine

In the illustration is shown the Barson type LTSa abrasive-wheel cutting-off machine introduced by Wandsbeker Werkzeug-Gesellschaft, Beinhoff & Co., 24a Hamburg-Wandsbek, Konigsreihe 14-16, Germany. It has a capacity for steel

bars up to 2½ in. diameter and tubes up to 4 in. diameter, and is normally provided with a handwheel-operated vice. Alternatively, a foot-operated vice can be supplied, which facilitates the rapid setting of the stock for cutting-off a series of parts of the same length. A vice which enables mitre cuts to be taken is also available.

Abrasive discs up to 20 in. diameter can be mounted on the spindle, which is driven by a 12-h.p. motor through a flat belt. The pivoted wheel-head is swung forward for the cutting operation by means of the handle at the top of the machine, and, at the end of the cut, it is returned by spring action when the handle is released. A feature of the drive arrangement is that the spindle speed can readily be adjusted to suit the disc diameter, so that a constant cutting speed of 20,000 ft. per min. is obtained. When a new disc is mounted on the spindle, the headstock is adjusted horizontally, by a handwheel, towards or away from the work, so as to bring the cutting edge of the disc opposite to a datum line on the machine. This action serves to adjust the drive, through gearing, so that the correct cutting speed is obtained. When the disc diameter has been reduced by wear, the headstock is again adjusted until the disc edge is opposite the datum line. An additional advantage of this arrangement is that the amount of free travel between the wheel and the work is kept constant, and operator fatigue is thus reduced.

The machine weighs about 7 cwt. and occupies a floor space of 30 by 22 in.

Barson Type LTSa Abrasive-wheel Cutting-off Machine

Gazelle Major Optical Projector

Letchworth Components Ltd., Works Road., Letchworth, Herts., have recently introduced the Gazelle Major optical projector shown in the accompanying figure.

Designed for use in a horizontal or vertical position, this projector is fitted with a lens system providing magnifications of 10×, 25×, 50× and 100×. The viewing screen, which measures 14 in. by 11 in., is mounted at a distance of 42 in. from the base of the projector. A 100-watt lamp supplied with current from the secondary winding of a 220-250/12-volt transformer is used as the light source.

The Gazelle Major Optical Projector

Work to be inspected is mounted on a table, which may be inclined to the right or left when the profiles of thread forms are to be checked. The focusing control is located above the slide which carries the light source. If required, thread form diagrams can be supplied for Whitworth, B.A., Metric and U.N.F. threads, also for special profiles.

Electric Industrial Furnaces were produced in this country during the third quarter of 1957 with monthly values of £845,000, £560,000, and £702,000. In addition, industrial furnaces of other types were produced, with monthly values of £703,000, £605,000, and £650,000.

Die Casting Supplement

The Necchi Die Casting Foundry

The business of Necchi, S.p.A., was originally established in Pavia, Northern Italy, in 1845, as a foundry. Today, the company operates a modern mechanized iron foundry with an output of about 1,200 tons per month, including castings in grey, malleable and spheroidal irons. Many of the malleable castings are made under contract, notably for the Italian motor industry. In addition to high-quality grey iron castings for the sewing machine division, malleable iron castings are produced for the wide range of pipe fittings made by the firm, to which reference will be made in another article, and the spheroidal graphite iron used is obtained by the magnesium process.

Some of the machining methods employed for the production of sewing machines, also the organization of the Pavia factory, were described in a series of articles which was published in MACHINERY early in 1956.* At that time, the company had been engaged in the production of sewing machines for about 37 years, having started to manufacture them after the end of the first world war. During the intervening period, it had become the largest maker of sewing machines in Italy and was producing at the rate of 1,000 machines per day.

By reason of far-sighted management policy, the sewing machines made by the Necchi organization are extremely modern both in design and external appearance. In this connection, the possibilities of the pressure die casting process for the production of sewing machine components, and especially arm castings, of modern aspect, were early realized. Advantage is taken of these possibilities, in the current designs of Necchi machines, to provide for neat and ingenious arrangements of various mechanisms, also to obtain economies in machining and ensure ease of assembly and finishing. A sewing machine incorporating a pressure die cast arm of aluminium alloy was introduced some years after the war, and such castings are now extensively employed for Necchi machines, and notably for the Supernova auto-

* MACHINERY, 88/116-20/1/56, 88/172-27/1/56, 88/422-13/4/56, 88/538-27/4/56 and 88/606-4/5/56.

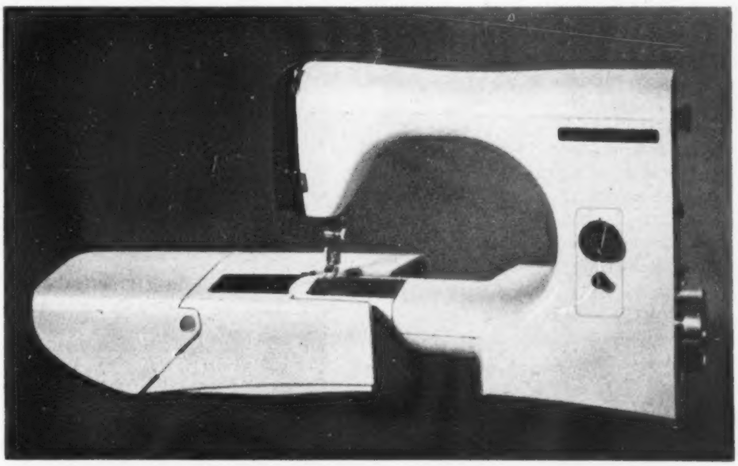


Fig. 1. A Necchi Mirella Sewing Machine of the Latest Type. The Use of Aluminium Die Castings has Permitted Many Design Improvements and has Enabled the Selling Price to be Reduced

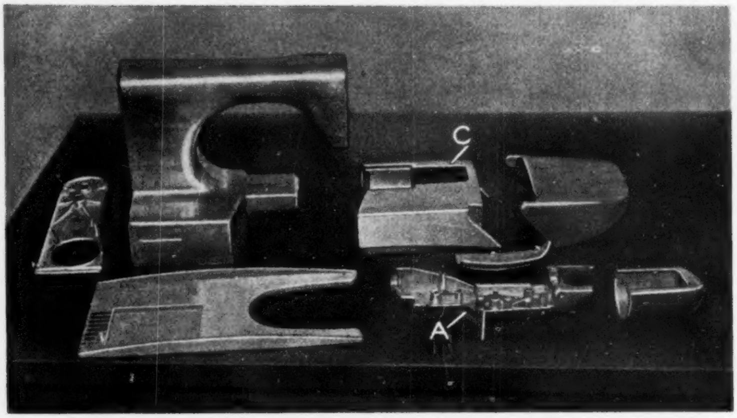


Fig. 2. A Group of Aluminium Die Cast Components for the Mirella Machine Shown in Fig. 1. The Projection from the Base of the Combined Arm and Bed Casting Houses the Motor

matic zig-zag-stitch type, as described in the series of articles mentioned above. The latest example of the application of die castings in sewing machine design is afforded by the newly-introduced Mirella machine illustrated in Fig. 1. Made in two different versions, this machine is intended for straightforward domestic sewing and darning, and it has an arm which is cast in one piece with the bed which encloses the shaft drive to the shuttle mechanism. In addition, the bed has a projection on the further side which houses the driving motor, so that the complete mechanism is housed in a one-piece casting. Problems associated with the attachment of the arm to the bed, for instance, and with the assembly of the mechanism, are thus simplified, and the cost of the machine reduced.

A set of aluminium die castings for the Mirella machine is shown in Fig. 2, where the combined arm and bed casting is seen from the opposite side, in order that details of the motor housing may be observed. In the final assembly, this arm-bed casting is supported on the flat base (in the foreground in Fig. 2 and painted black in Fig. 1), and the shuttle mechanism is fitted into the somewhat complicated casting A, which is then assembled into the bed. Another feature of the Mirella machine, which has largely been made possible by the imaginative use of die castings, is the shroud for supporting the work material during normal sewing, shown in the half-engaged position in Fig. 1. This shroud is made from the two castings at the upper right in Fig. 2, which are hinged together on assembly, and it clips into place over the extension of the free arm.

When the series of articles mentioned above was prepared, the company was buying die castings from contract foundries, of which there is a number in Northern Italy, but the installation of a modern pressure die casting foundry has since been completed at the Pavia factory, and is now in full production, supplying all the castings required. The foundry, and some of the more

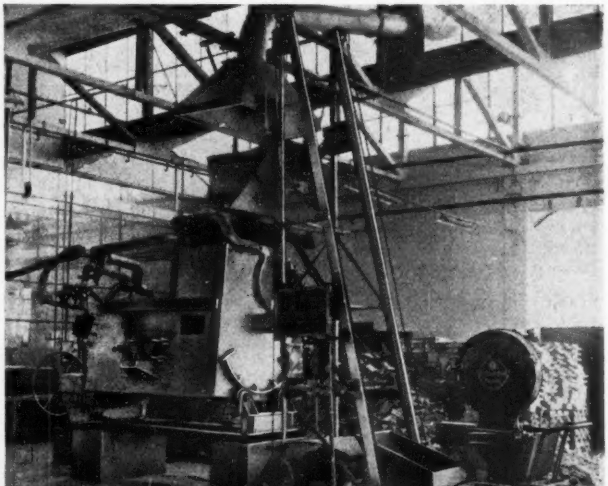
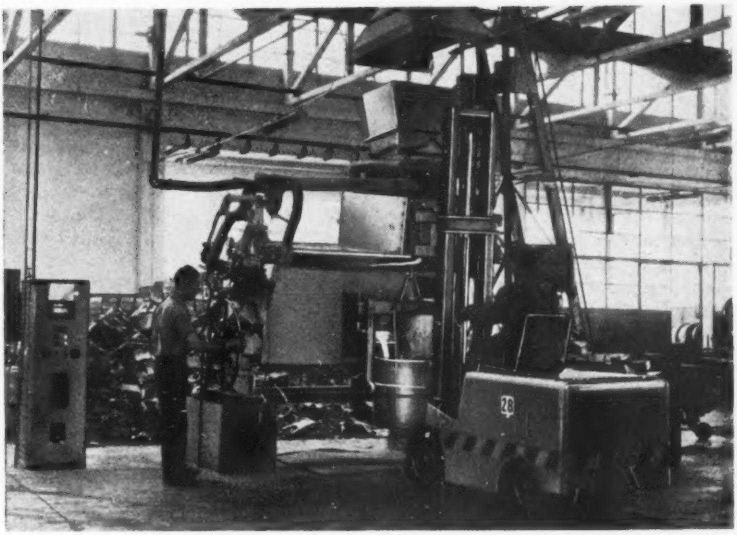


Fig. 3. This Sklenar Furnace, which has a Capacity of about 400 lb. and was Made Under Licence in Italy, Provides for Melting Aluminium for all the Machines in the Foundry

Fig. 4. The Furnace in Fig. 3 May be Tapped at Intervals of 20 min. or Less. Metal is Conveyed to the Holding Furnaces Adjacent to the Machines with the Aid of the Fork-lift Truck Shown



interesting of the castings now being made, including the Mirella arm-bed casting, form the subject of this article, and another to be published later.

THE DIE CASTING FOUNDRY

The new pressure die casting foundry occupies an area of about 27,000 sq. ft. in one half of a rectangular building, which is separated from an area devoted to the finishing of malleable iron pipe fittings, made in large quantities by the iron foundry, by a central longitudinal partition. Output of the foundry is approximately 55 tons of castings per month, of which 40 tons are of aluminium and the remainder of zinc-base alloys. Of these castings, the heaviest weighs about 7 lb., but for the normal run of arm castings, for instance, the weight is in the region of 4¾ to 5 lb. At one end of the foundry there is an area employed for melting all the aluminium alloy consumed, and for this purpose the Sklenar rotary tilting furnace shown in Fig. 3 is exclusively employed. Built under licence in Italy by Societa Forni Elletrici Alta Temperatura, this furnace is fired by methane gas obtained from natural sources and piped to the factory. It is estimated that this fuel reduces the cost of melting to only one tenth of that for electric melting. Methane is also employed for heating the entire factory from a central installation. The melting furnace consists of a refractory-lined rectangular box, with curved supporting strips welded to its end surfaces. These strips rest on pairs of rollers, and by turning one of the rollers with the handwheel, through a reduction gear, the complete furnace may be tilted for tapping. Molten metal emerges through an opening at the front of the furnace into a large ladle carried on a fork lift truck, as seen in Fig. 4, whereby it is transferred to one of the holding furnaces for the die casting machines.

The melting furnace is open at the top for the escape of the burnt gases which are conveyed outside the building by exhaust trunking connected to the hood above. Since the gases cover the charge in the furnace, and the surface of the molten metal is also covered with large salt granules supplied by Foundry Services, Ltd., the formation of dross is reduced, hydrogen pick-up is eliminated, and the heat is largely retained in the charge. The opening at the top of the furnace also provides for charging it with ingot or scrap material, which is initially loaded into the skip of the hoist at the right in Fig. 3. Loads of 90 to 110 lb. can be placed in the skip, which is raised into the overhead charging position by an electric motor through a wire cable and winch mechanism, under the control of the operator. The sides of the winch are equipped with rollers which run in channel-section tracks secured to the inside of the framework, and, at the top, these tracks are curved over, so that the leading edge of the skip is tilted forward as it rises, and the material is discharged into the furnace. Between three and four loads are needed to fill the furnace, which has a nominal capacity of about 400 lb., and, with the furnace hot,

this amount can be melted in a period of 20 to 30 min. A completely filled furnace will normally last several die casting machines for a few hours, but, when metal has been drawn off, the melting furnace is usually topped up at once, unless a different alloy is to be melted. For alloying purposes, a scale having a weighing platform level with the foundry floor is provided, as seen at the right in Fig. 3, together with a three-wheeled barrow for moving the material.

Die casting operations in the Necchi foundry are considerably simplified by the use of only two standardized aluminium alloys for sewing machine castings. These alloys are chosen with a view to facilitating the production of satisfactory castings, and each has sufficiently good physical characteristics to withstand the light stresses imposed. For castings of simple shape which present no difficulties in running, an alloy containing silicon 8·5 to 9, copper 3 to 3·5, iron 0·8 to 0·9, and manganese 0·2 to 0·3 per cent—and the remainder aluminium—is employed. Castings having more complicated shapes, or with very thin sections which are difficult to feed, are made from an alloy of silicon 10 to 11, copper 2 to 2·5, iron 0·8 to 0·9, and manganese 0·1 to 0·2 per cent, the remainder being aluminium. Normally, metal melted from ingot material is only sample analysed occasionally, but, when scrap is being remelted, a check is made at least twice daily on the chemical composition with the aid of the instrument shown in Fig. 5. Supplied by Optica of Milan, this spectrophotometer operates on the principle of light absorption to determine the amount of certain elements in liquid solutions. Light from a tungsten lamp is directed through a glass prism of 90 deg. constant deviation and is allowed to pass through a cell containing a solution prepared from the sample to be analysed. After passing through the solution, the light falls on a photo-electric cell, and its intensity is shown on a galvanometer at *B*, which can be observed by the operator standing at the left-hand side.

The galvanometer reading is adjusted by varying the intensity of the light by means of a mask with a slit, through which the light passes to the sample. Another cell containing a standard solution is then substituted for the first, both cells being initially placed on a sliding platform, and the galvanometer reading is again adjusted. The difference in the amount of light transmitted by the two solutions can then be read directly from a scale and the amount of the particular element present can be calculated. For the determination of the amount of a single element in a sample, these operations, including the preparation of the solution, occupy about 1¼ hours, but if four elements are involved, only a further ¾ hour is required. The method is very precise and permits the measurement of manganese, for instance, to be carried out with an accuracy of 0·02 per cent of the total amount present. In an alloy containing about 10 per cent of silicon, the exact amount present may be determined within 0·3 per cent.

DIE CASTING PLANT

Adjacent to the central melting area of the foundry there is a centralized pumping house, just visible in the background at the right in Fig. 4, which supplies a mixture of water and 5 per cent soluble oil for the water-hydraulic die casting machines that constitute the major part of the plant installed. A view inside this pumping house showing the three pumps is given in Fig. 6. Supplied by A. Triulzi, S.A.S., of Milan (Alexander Cardew, Ltd., 2-5 Studio Place, Kinnerton Street,

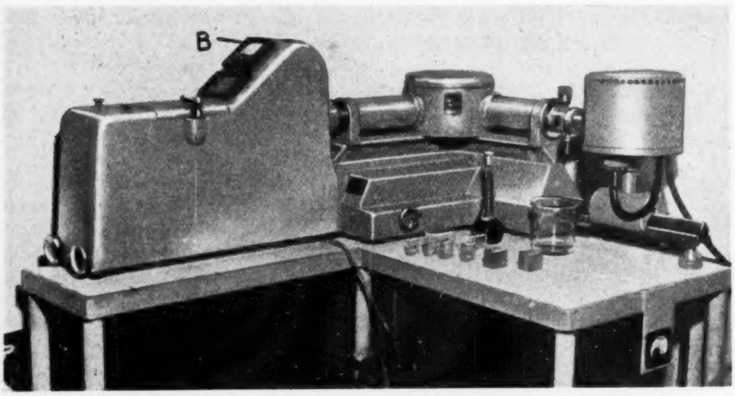


Fig. 5. On this Spectrophotometer, Supplied by Optica of Milan, Tests of the Chemical Composition of the Melted Scrap are Carried Out Twice Each Day. The Amounts of Four Elements can be Determined in about 2 hours

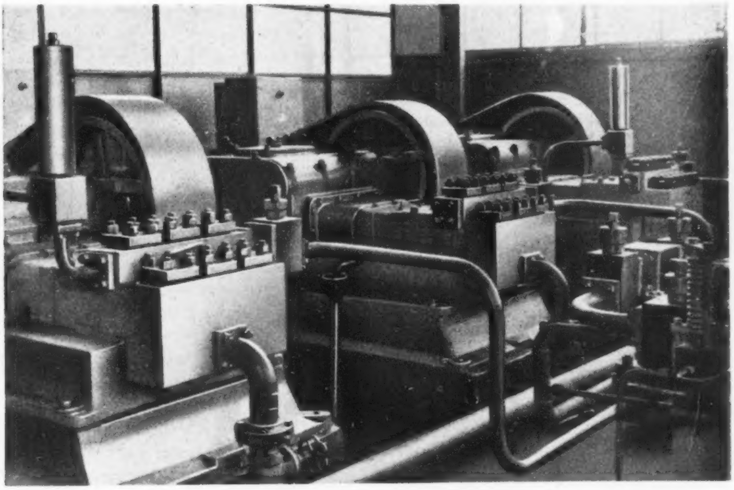


Fig. 6. A Mixture of Water and 5 per cent of Soluble Oil is Supplied at a Pressure of 2,130 lb. per sq. in. by these 3-cylinder Pumps for the Operation of the Triulzi Machines

London, S.W.1), the pumps are all of similar design and capacity, and each has three horizontally-disposed cylinders, and is driven by a motor of 58 h.p. Two of the pumps are operated together and the third is held in reserve in case of breakdown, and to allow routine maintenance to proceed without interrupting production. Each pump can deliver slightly more than 26 gal. per min. at a pressure of 2,130 lb. per sq. in., and the fluid is initially pumped into a battery of steel bottle type accumulators on one of the walls of the pumping house.

From these accumulators, the water is conveyed to the individual die casting machines through large-diameter steel pipes accommodated in channels in the foundry floor. Before the fluid is distributed, it is passed through a heat exchanger coil for cooling and a filter to ensure that dust and dirt are not carried into water passages and valves. Automatic unloading valves between the pumps and the accumulator bottles enable liquid to be returned directly to the storage tanks, and relieve the load on the pumps so long as pressure is maintained in the system. Each accumulator bottle is initially charged with air at a pressure of about 1,700 lb. per sq. in., and is fitted with a minimum-pressure valve which prevents the escape of air into the system should the water pressure fall below this value. Other, smaller accumulator bottles, charged with air and connected to the pressure supply, are provided for the water-hydraulic machines, for operation of the injection plungers at the required high speed.

As stated above, the major part of the Necchi

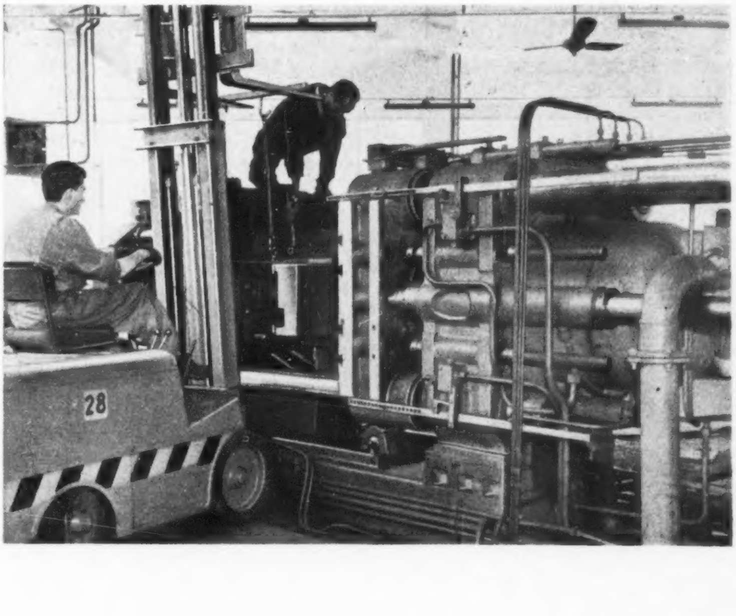


Fig. 7. Removing a Die from the Largest of the Triulzi Machines with the Aid of the Electrically-powered Fork-lift Truck. The Machine has a Die-locking Force of 750 tons

plant consists of water-hydraulic machines, and these are of Triulzi make, and of both the hot- and cold-chamber types. The largest machine in the foundry is the Triulzi type 16,000 cold-chamber unit shown in Fig. 7, which is capable of exerting a die-locking force of 750 tons, and is of similar construction to that described in MACHINERY, 82/782—24/4/53. In addition, there is a 350-ton, a 250-ton, and three 150-ton Triulzi machines of the cold chamber type, also two Bühler (Bühler Brothers), oil-hydraulic, cold-chamber machines of 400 tons capacity. Hot-chamber casting of zinc alloys is carried out on one Triulzi Z30 and two Z25 machines, of 90 and 60 tons capacity respectively, and one Idra machine of 80 tons, to which further reference will be made later. The construction of the Triulzi machines is generally similar to that of the large unit shown in Fig. 7, pressure being applied for closing the dies, and for holding them in the closed position, by the piston in the large hydraulic cylinder visible at the right-hand side. This large cylinder is cast integrally with the fixed platen which, like all the machine members, is of steel. Pressure is applied by the cylinder in only one direction, for die locking, power for opening the dies being obtained from two smaller cylinders, one on each side of the machine.

After a period of use, each die is taken to a maintenance area in the foundry, and is thoroughly cleaned and checked. At the same time, any repairs that are required are carried out before the die is stored so that it is ready for service. In Fig. 7, the die for making the Mirella combined arm and bed casting, shown in Fig. 2, is being removed from the machine with the aid of a fork lift truck. Supplied by Turrinelli of Milan, this truck is electrically powered and has a lifting capacity of 1,500 kg. (3,300 lb.). In addition to facilitating the installation and removal of heavy dies, the truck is employed for such purposes as the transport of liquid metal from the melting to the holding furnaces of the individual machines, and for the installation of new cast iron crucibles in the holding furnaces. This operation is seen in progress in Fig. 8, on a holding furnace for one of the smaller Triulzi cold-chamber machines. Heated by electrical resistance elements, these holding furnaces are of two sizes with capacities of 140 to 160 kg. (300 to 350 lb.), and 80 to 90 kg. (176 to 198 lb.), and it is the smaller which is shown in the illustration. The crucibles are cast from spheroidal graphite iron in the company's foundry, and some details of the advantages to be obtained from the use of this material were given in a paper by Mr. L. Oltrasi, read at the second European Pressure Die Casting Conference in Paris last year, as reported in MACHINERY, 90/1464—28/6/57. Crucibles made from ferritic (completely annealed) spheroidal graphite cast iron have been found to last up to six times as long as those made from grey iron when used for aluminium alloys, and up to four times as long when used for zinc. Iron pick-up by the zinc is also reduced in about the same proportion. In practice it has been found to be preferable to remove each crucible for renewal of the refractory coating after two days use, to prevent iron pick-up by the aluminium.

In addition to crucibles, it was pointed out in the paper, plungers for casting both zinc and aluminium alloys, also goosenecks for hot-chamber machines, can, with advantage, be made from ferritic spheroidal graphite iron. On the large Triulzi 16,000 machine, for instance, it was found that the number of shots could be increased from 450 for machining-quality grey iron to 4,000 for the S.G. iron. On the Triulzi Z30 machine, the number of hours that grey iron plungers withstood immersion in molten zinc was

Fig. 8. A Fork-lift Truck is also Employed for Removing and Installing Crucibles. The Latter are of Ferritic Spheroidal Graphite Iron and have a Much Longer Life than Grey Iron Crucibles

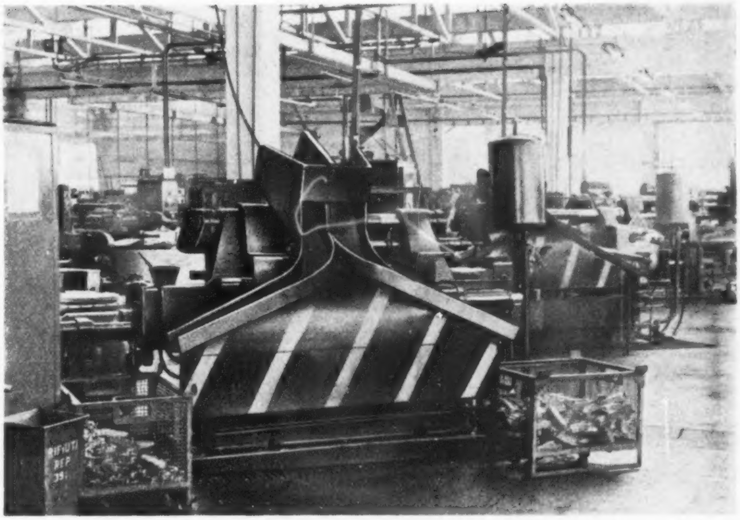


Fig. 9. On Small Die Casting Machines Chutes are Fitted for the Convenient Disposal of Castings and Sprues which Slide into Box Pallets at the Rear

45, but with S.G. iron the time was increased to 375 hours. These plungers are now rough-machined on a lathe before being finally annealed by heating to a temperature of 870 to 880 deg. C. Quenching in oil to obtain a hardness of 38 to 42 Rockwell C. follows, and finish-machining is then carried out. The hardness of the plunger is selected to avoid any significant wear in the sleeve bore. Goosenecks for the hot-chamber machines are also made from ferritic S.G. iron, and their life has thus been extended from 1,500 hours for grey iron, to 4,000 hours.

HANDLING CASTINGS

Considerable attention has been paid in the Necchi die casting foundry to the problem of handling castings, since their transport from the foundry to the fettling shop, and the different sorting operations which they must undergo, can be very costly if not properly planned. In many shops it is usual to provide the operator with a box pallet in which the completed castings are placed, but these pallets tend to occupy considerable floor space on the operator's side of a machine, and may restrict his movements. For this reason, the arrangement shown in Fig. 9 has been adopted, so that the box pallets can be placed at the rear of the machine. Here, the row of smaller Triulzi machines, mentioned earlier, is seen, and it may be noted that they are installed at an angle so that the die openings are not in line, and there is no risk of metal splash injuring the operators of adjacent machines. At the rear of each machine is fitted a sheet metal guard which incorporates two curved chutes. On the operator's side of the machine, the openings to these chutes are adjacent, but towards the rear, the chutes curve away to each side. When a spray is taken from the die, the operator breaks off the castings, and if they are of different designs he places them in separate chutes. The sprue is then placed in a pallet on his side of the machine. Where only one type of casting is being made in the die, the casting is placed on one chute and the sprue on the other, and they slide down into the pallets shown. Plenty of space is thus left on the operator's side of the machine, and there is also sufficient room for the operator of the fork-lift truck to remove the full pallets and replace them with empty ones. Easily removable, fixed guards mounted on the die casting machines are painted black with diagonal yellow stripes, so that they may be readily recognized. Air circulation fans and exhaust systems, installed in the roof spaces, provide some relief from the heat during the Italian summer.

Where a die casting machine is operated too rapidly to permit the operator to remove castings from the sprays as they are produced, the sprays are placed directly in boxes, and they are then handled with the aid of equipment similar to that shown in Fig. 10. A conveyor belt about 10 in. wide, made from jointed steel plates, is continuously driven from one end by a small geared motor, and a sloping sheet metal guard along each side prevents parts from falling off. At several positions along the conveyor there are sorting stations, one of which is seen in Fig. 10, with a horizontal chute leading to the conveyor belt. Above, there are two other, curved chutes, of similar layout to those on the machine in Fig. 9, which slope towards boxes on the side of the conveyor opposite to the operator. A box of casting sprays is placed in a convenient position, close to the sorting station and at a convenient height for picking up the

Fig. 10. Where Machines are Operated at a Rate Such that there is Insufficient Time for the Removal of Castings from the Sprays, the Work is Carried Out Subsequently at a Sorting Conveyor. Scrap is Carried by the Conveyor Belt to a Box Pallet for Transfer to the Re-melting Area

castings. The sorter then breaks the castings from the sprays and places them in one of the upper curved chutes, the sprues and runners being placed on the horizontal chute and pushed forward so that they fall on to the conveyor belt. This scrap material is carried along to the end of the belt and falls eventually into another box pallet in which it is subsequently removed and transported to the re-melting area.

Beyond the far end of the conveyor in Fig. 10 is the area devoted to fettling castings, which is equipped with conveyor belts to carry the parts to the various fettling stations on each side of a belt. In addition to the conventional hand tools, these stations are equipped with abrasive belt machines with air extraction ducts, so that not only can flash be removed, but also die joint marks where they occur on a plain surface which is to be finished by painting. The fettling area includes a line of machines on which early machining operations, performed mainly with the object of removing rags from cored holes, may be carried out on some of the larger castings, as will be explained later. Sufficient capacity has been provided in the fettling shop to permit single-shift working, but the die casting shop is at present operated on a two-shift system, from 6 to 2 and 2 to 10. A single shift is also worked in the remainder of the factory, and a period of 1 hour is allowed for lunch. Interruptions to die casting production, and the temporary reduction in quality of the castings produced, is minimized by allowing only 30 min. for lunch in the foundry, the machine operators being compensated by being paid for this non-working period.

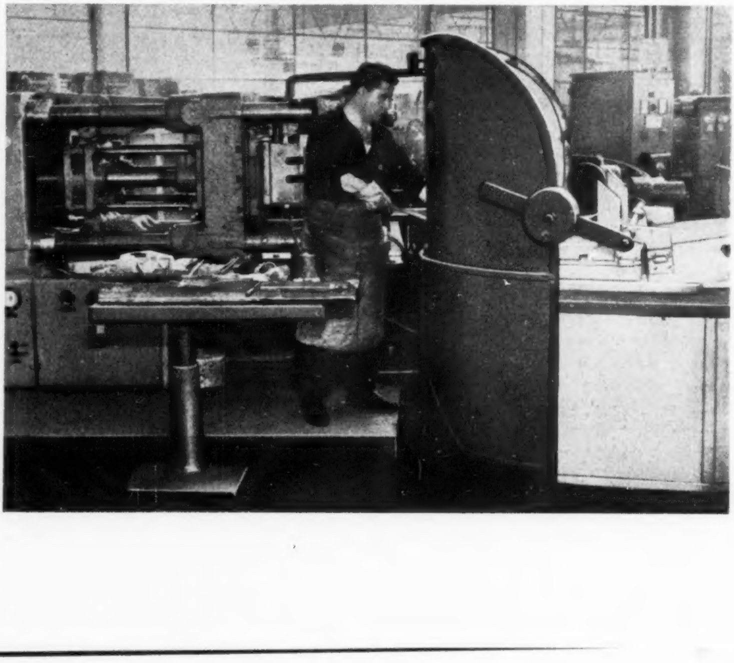


Fig. 11. Protection of the Machine Operator from the Heat of the Metal in the Holding Furnace, During the Ladling Operation, is Afforded by an Asbestos-lined Sheet Metal Guard

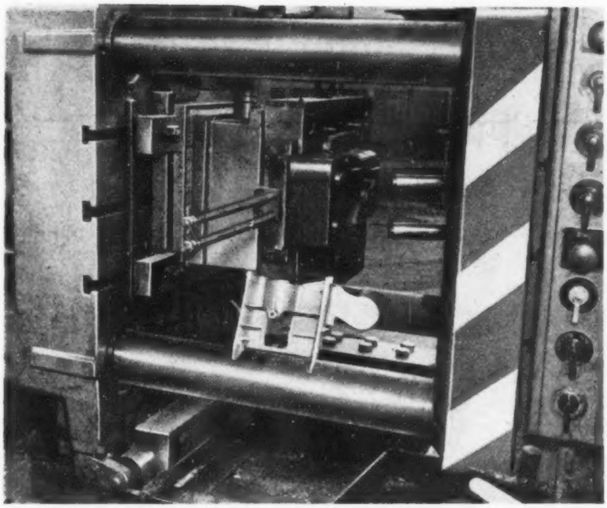


Fig. 12. Close-up View of the Die on the Bühler Machine in Fig. 11, Showing the Arrangement of the Moving Core which is Completely Enclosed in the Cavity in the Fixed Half when the Die is Shut

SEWING MACHINE MATERIAL SUPPORT CASTING

The casting at *C*, in Fig. 2, which forms the support for the material on the Mirella machine during normal sewing, is produced on the machine shown in Fig. 11. This Bühler machine of 400 tons capacity, to which earlier reference was made, is equipped with the larger of the two sizes of bale-out furnace, of 140 to 160 kg. (308 to 352 lb.). Protection against the heat of the metal in the furnace during the ladling operation is afforded by the sheet metal, asbestos-lined guard partially surrounding the furnace, an aperture being provided through which the ladle is passed to reach the molten aluminium. The Bühler machine is of conventional construction with four tie bars, and the moving platen is operated through double toggle-links by a hydraulic cylinder. A 3-phase injection system is employed, and provision is made for the speed of movement, the pressure applied, and the duration of each phase to be adjusted, so that a very flexible control of the casting process is possible. In the first phase of the plunger movement, the end of the plunger moves slowly past the ladling hole, allowing the air trapped in the sleeve to escape. This slow movement also prevents the metal from spurting out of the hole as might otherwise happen when the sleeve is almost filled with metal.

During the second phase, an accumulator is connected to the cylinder for operating the plunger, and then the latter moves forward very quickly, so that the cavities of the die are filled rapidly, and with the minimum of premature solidification. A high-pressure pump then applies a final larger force to the metal during the solidification period, so that porosity is reduced and the micro-structure improved. The machine is operated on an entirely automatic cycle for the production of material support castings, and a close-up view of the die is given in Fig. 12, where a casting, with the sprue still attached, is seen in the foreground.

In the trimmed condition, the casting weighs 17 oz., and in addition to the long runner bar which extends along one side, and provides some additional heating for the die, there are two overflows on the upper edge, at the left, that are not shown in the figure. The core employed with this die, after being moved inwards by the angle pins, against the pressure of the return springs, enters a space in the cavity of the fixed die member.

An inclined surface on the outer face of the core fits against a surface machined at a similar angle in the cavity, so that, when the die is shut, the core is completely enclosed, and cannot move under the pressure of the injected metal. The surfaces of the moving core form the end faces, seen uppermost on the casting in Fig. 12, also the inner surface of the curved portion which fits over the arm extension in the finished assembly. The remainder of the casting surfaces are formed between the opposing die faces. This casting is manually ejected, but normally ejector pins are hydraulically operated. A solidification dwell period of 25 sec. is allowed for this casting, which is made from the alloy containing the lower amount of silicon quoted earlier, since it is of simple form.

For each die in use in the Necchi foundry there is a set of sheet metal guards, as seen at the right in Fig. 12, which at least cover the die parting line to prevent escape of metal spray from the machine. These guards accompany the dies on the special pallets which are employed for die storage.

A further article devoted to the new die casting foundry of Necchi, S.p.A., Pavia, Italy, and the methods and equipment that are employed therein, will be published shortly in MACHINERY.

Handling and Storage Arrangements at the Timken Shipping Centre

As part of a new integrated system for recording and executing orders, controlling stocks and manufacturing schedules, and stocking and dispatching bearings, The Timken Roller Bearing Co., U.S.A., established a shipping centre at Bucyrus, Ohio, which has now been in operation for 18 months. The headquaters of the company are at Canton, Ohio, where an IBM650 computer, which is an essential part of the system, is installed. This computer takes account of stocks, production schedules, and outstanding orders, and indicates rapidly whether a customer's delivery date request can be met. It is not proposed here to describe the system, but merely to discuss some of the work handling and storage arrangements at the shipping centre.

The building, which was completed in less than 12 months, has a floor area of 140,000 sq. ft. It provides for the storage of 12 to 15 million bearings, and the 223 employees, with the aid of efficient packaging and handling equipment, ensure the dispatch of some 10 million bearings each month, representing 95 per cent of the company's bearing deliveries. A diagrammatic plan showing the layout of the building is given in Fig. 2.

Bearings are delivered by road from the various production plants and are received at one of six docks at the left hand end of the building. All bearings are transported in pallets which are unloaded from the lorries by means of fork-lift trucks. The storage area which occupies some two-thirds of the 540-ft. long by 240-ft. wide floor

Fig. 1 (above). Bearings Arriving in Pallet Loads are Handled and Stored Directly by Fork-lift Truck

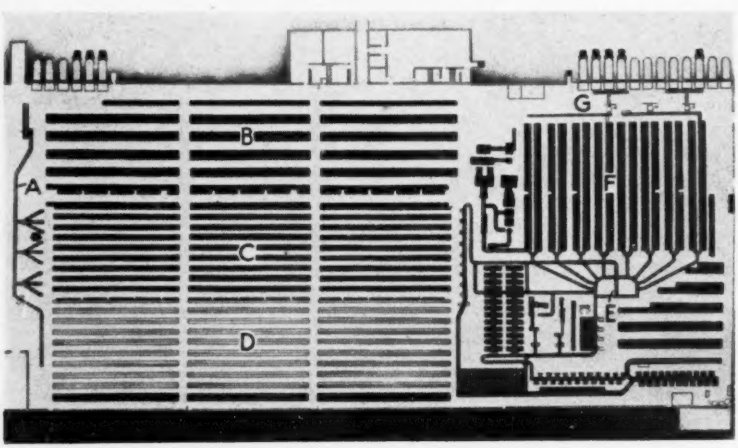


Fig. 2 (left). Diagram Showing the Layout of the Timken Shipping Centre. *A*—3-deck Conveyor with Switching System for Directing Boxes to Individual Gangways. *B*—Pallet Storage Area. *C*—Box Storage Area. *D*—Bin Storage Area. *E*—Central Transfer Station. *F*—Packing Area. *G*—Banding, Demagnetizing, and Weighing Area

area is divided into three sections for the reception of pallet, box, and "bin" deliveries. Full pallets, each loaded with bearings of one part number, are taken directly by the truck to the pallet storage section and placed in racks as seen in Fig. 1. Those pallets which contain mixed loads are placed by the truck on a conveyor whereby they are carried to a pallet unloader. Here, the boxes are automatically removed and the empty pallets are stacked. From the unloader, the boxes pass on a conveyor to an IBM key punch operator who assigns them to various storage lines and spaces.

There is a 3-deck conveyor system extending across the end of the building as seen in the background in Fig. 3, and each conveyor run terminates in a 3-way switching point whereby boxes are directed to the individual gangways. From the delivery conveyors in the foreground of Fig. 3, the boxes are carried by chain-type floor conveyors to the selected gangways. They are lifted from the conveyor to the allotted storage spaces by means of the box lift truck seen in Fig. 4, and the system is such that the boxes reach the gangway in the right order according to their destinations, so that the floor conveyor may be cleared at one passage of the truck.

When the bearings are received in less than "full-box" quantities they are consigned by the key punch operator to the bin section where they are placed on small trailers drawn by tricycle-type electric tractors.

Fig. 4. In the Box Storage Area, Boxes are Lifted from a Floor Conveyor by a Special Truck

The centre is operated on a 3-shift system, and during the night shift, all bearings required for dispatch next day are taken from the racks and bins. Boxes, and bearings taken from bins, are carried by conveyor to a central transfer station, located about 5 ft. above floor level, for delivery to the different packaging or packing area. (The term packaging implies wrapping the bearings in treated paper and placing them in cartons, prior to packing in containers or boxes for shipment.) Although some small orders are packaged by hand, the majority of this work is carried out by automatic cartoning machines of the type seen in Fig. 5. This machine wraps and heat-seals the

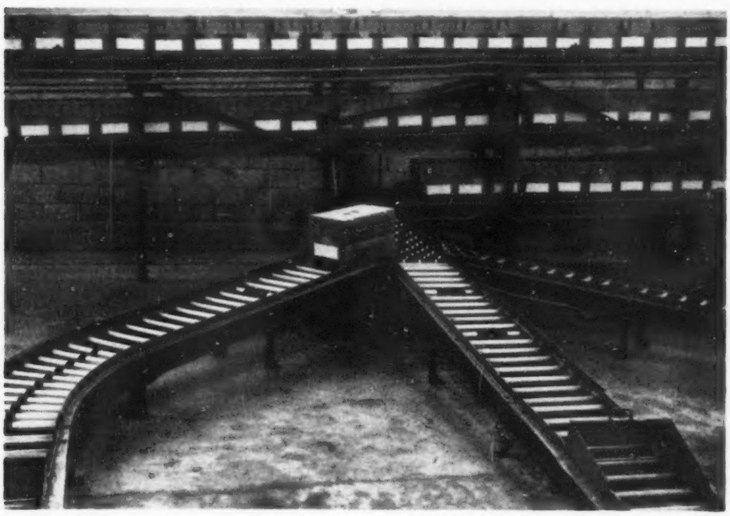


Fig. 3. Bearings Arriving in Full-box Quantities are Consigned by a Conveyor and Switching System to the Box Storage Gangways

bearings, imprints the Timken part number and nomenclature on the carton, inserts the bearings in the carton, and finally seals the carton. During an 8-hour shift, it will handle about 15,000 bearings.

When packaging has been completed, either by standard or special procedure according to requirements, the cartons are placed on a storage conveyor. Thence, they are returned to the central transfer station during the night shift, and are finally consigned to a packing station. There are 16 packing benches, some of which are seen in Fig. 6, and each bench is divided into four sections to provide a total of 64 stations. All cartons required to complete an order are assembled at one station, and when the entire consignment has been packed, the boxes are moved by roller conveyor to a weighing and handling station. Before dispatch, all boxes are banded, demagnetized, and weighed. Portable roller conveyor units are provided to facilitate loading lorries.

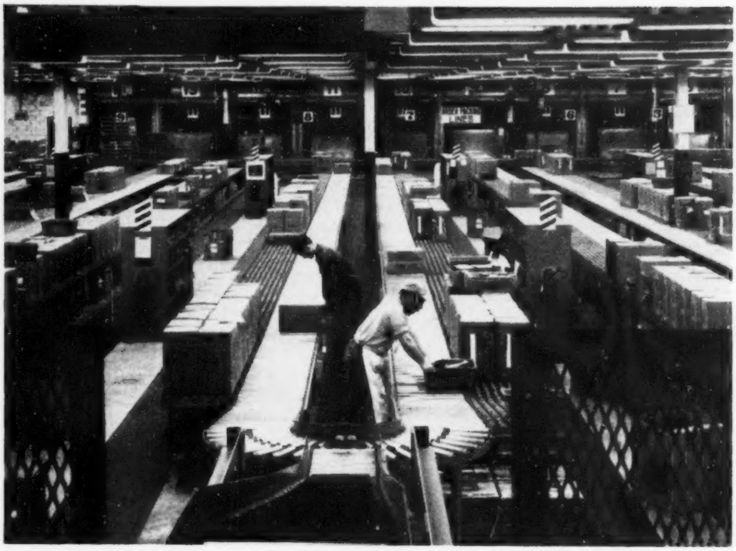


Fig. 6. A General View of the Packing Area

The system enables an order to be completed at a pre-determined time and the haulage contractor is notified in advance, so that the vehicle can be loaded without delay.

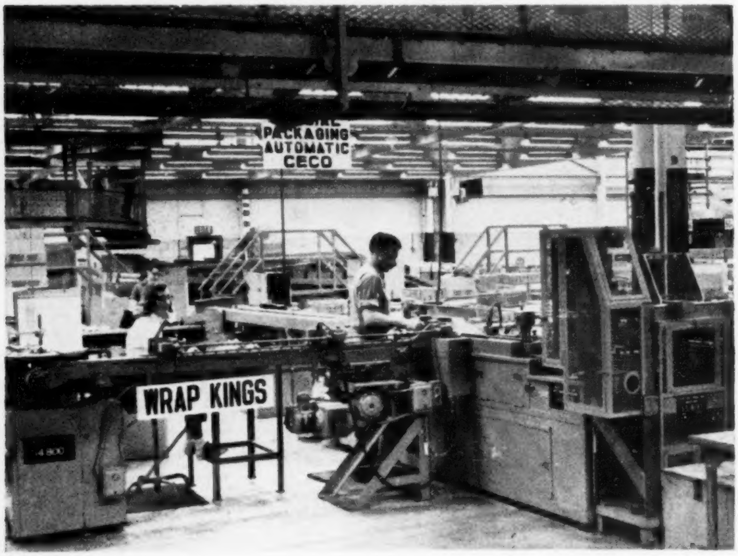


Fig. 5. Where Packaging is Necessary it is Carried Out on Automatic Machines of the Type Shown Here

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PRODUCTION OF MOTOR CYCLES in the United Kingdom during 1957 averaged 13,880 per month, of which 3,970 were exported. For comparison, the average monthly production during the year 1956 was 10,400 machines.

Maintenance Control in the "Automatic Factory"

The overall efficiency of an " automatic factory " is almost entirely dependent on a consistent flow of workpieces along the production line, and it is to this end that elaborate work-handling and conveyor systems are now being increasingly developed. A common feature of such flow-line systems is the incorporation of storage units, where a head of workpieces can be collected to ensure that the continuity of production will not be interrupted for want of parts. Many machines are fed with parts by way of gravity-feed hoppers, and these, by their very nature, must be positioned above the machines concerned, and, in turn, be replenished by elevators which raise the workpieces by mechanical or magnetic means. Between the hopper and the machine, there is often need for a re-orientating mechanism, which will sort the workpieces and deliver them to the machine in the correct position for the relevant operation. Precautions must be taken against overloading the delivery chutes, and it is often necessary to determine the minimum and maximum quantities of parts in these chutes, by means of switches which control the hopper drive motor.

All such systems are potential sources of failure, that must be considered in addition to the normal break-downs which may occur on the machines themselves, and the failure of any mechanism, at any point in the line, will interrupt the flow of work, or may ultimately result in a shut-down of the entire plant. The importance of continuous routine maintenance cannot be over-stressed, but, in the event of a failure which causes an interruption in continuity of work-flow, the first essential must be the speedy location of the break-down. This task may present considerable difficulties, which can be overcome successfully only by the adoption of some form of centralized control system, such as that seen in Fig. 1. This equipment was developed, in co-operation with the British Motor Corporation, Ltd., by Bonochord, Ltd., 48 Welbeck Street, London, W.1. [It should be noted that the automatic control system division of this company has now been transferred to W. E. Electronics (Production), Ltd., Brunel Road, East Acton, London, W.3.]

THE CONTROL EQUIPMENT

The central portion of the control equipment is a schematic diagram of the layout and flow-lines of the complete plant, and coloured lights are employed to indicate the positions of drive motors, all mechanisms which are potential sources of

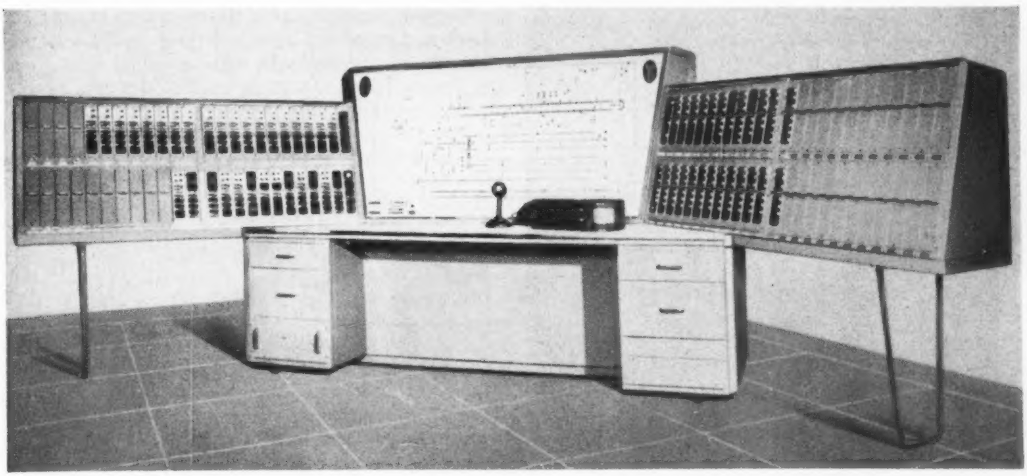

Fig. 1. The Control Console and Illuminated Flow-line Diagram for a Large " Automatic Factory " Engaged in the Production of Motor Cars

failure, and the emergency stop-buttons which are located throughout the factory. Different colours are used to represent the various types of failure which can occur, and an audible warning is arranged to operate simultaneously with the lighting of any indicator lamp. A colour key-chart for the indicator lamps is located at the bottom left-hand corner of the diagram. On the desk-top, immediately in front of the diagram, is the microphone of a public-address equipment, which enables the controller to speak directly to the maintenance crews that are stationed at strategic points throughout the plant. A duplicate microphone and amplifier circuit are provided, for use in the event of failure of the other equipment. Maintenance engineers can speak to the controller by the telephone which stands at the right of the microphone, and arrangements are provided for any widely-separated maintenance crews to speak to each other, through the same switchboard.

The wings, which extend from the right- and left-hand sides of the central diagram, house the control and fault indicator units, of which a typical example is shown in Fig. 2. There is a separate control, or indicator unit for each drive motor, hopper, and conveyor, and for any other mechanism which is considered to be a potential source of interruption to the continuous working of the plant. The unit shown in Fig. 2 is used for controlling a drive motor, and the buttons and pilot lights at the top are for starting and stopping the motor, and for giving a visual indication of which button has been pressed. Immediately below these controls is a tumbler switch, which is used if it is required to transfer control of the motor to the shop floor, during maintenance, for example. This switch, also, has an associated pilot light. The four lights at the bottom half of the unit serve to identify failures caused by the breaking of two separate shear-pins in the mechanism which is driven by the motor, and over-loading of the associated hopper. Each control unit is secured to the housing by two screws, and as all connections are made by plugs and sockets at the rear it may be removed readily for repair or maintenance.

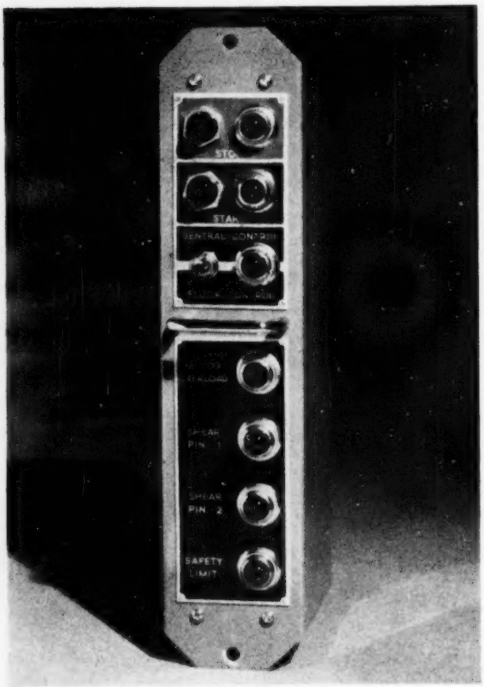

Fig. 2. Close-up View of One of the Control Units seen Housed in the Wings at Each Side of the Control Diagram in Fig. 1

BREAKDOWN WARNINGS

Warning of any breakdown which may occur is given to the controller by three separate methods. Firstly, an audible signal is sounded, and, simultaneously, an indicator light on the diagram panel shows the exact location of the fault. At the same time, a pilot light on the relevant control unit indicates the type of failure involved. Having assessed this information, the controller notifies the necessary maintenance engineers, who correct the fault and report by means of the telephone system already mentioned. It will be noted that there are many blank spaces in each of the control unit wings, and these are provided for housing further units as the plant is expanded, and extra machines and conveyors are added. Each of the blank spaces is already wired, so that additional control units require to be plugged-in only.

Several hundred wires are needed to connect equipment of the type shown in Fig. 1 to the plant it controls, and all the external connection points are grouped together on a large vertical panel, which is accessible from the rear of the desk. The back of this panel can be seen through the knee-hole portion of the desk. Drawers, at the right and left of the desk, house the ancillary electrical equipment required for the control system, also spare control units, fuses and vacuum tubes. It has been found, in practice, that the larger an automatic plant becomes, the greater is the frequency with which the layout is changed, and it is obvious that the actual construction of

the control desk and wing panels must be such that alterations and additions can be accommodated readily. In accordance with this requirement, the equipment shown in Fig. 1 is designed on the unit construction principle, and parts may be added or removed, as required.

METHODS OF DETECTING TROUBLE

As has already been mentioned, a fully automatic plant is extremely vulnerable to break-down at a number of points, but provided any anticipated failure lends itself to detection by automatic sensing methods, provision can be made for most eventualities. In the case of a conveyor, or similar work-handling system, jamming or overloading of the mechanism will make itself apparent, immediately, in the overload relays of the associated driving motors. These relays can be arranged as parts of an indicator circuit, in addition to their normal duty of protecting the motor concerned. Similarly, shear pins can be fitted in sections of the conveyor drive, and so arranged that, in the event of any jamming or overload, the fracture of a pin will complete an electrical circuit, and energize the warning system. Some conveyors require two or more driving motors, and the failure of one of these motors may place an increased load on the remainder, which can cause overheating of the windings, also out-of-balance stresses in the conveyor itself. Both these occurrences lend themselves to automatic sensing, and consequent completion of alarm circuits. An alternative method, which can be employed in multi-motor driven conveyors, is the fitting of a centrifugal switch in association with each motor. While a motor is running, the switch is held open, but should a failure take place and the motor either slow down, to a pre-set minimum speed, or stop altogether, the switch will close, to complete a warning circuit.

Limit switches are employed extensively throughout an automatic factory and obviously are very suitable for transmitting signals and warnings. Generally, a pair of auxiliary contacts is provided for this duty, but this arrangement in itself, is another potential source of failure, as these contacts may short-circuit, without any external intervention, thus transmitting false information to the control desk. Wherever possible, therefore, the circuit should be arranged so that the working contacts of the switch also operate the alarm system.

As an example of the advantages offered by a centralized information and control system, a main conveyor, which is supplied, partially, with workpieces from an auxiliary conveyor, may be considered. With such an arrangement, precise synchronization must be maintained between the two conveyors, and one must not be allowed to operate if the other is stationary, lest their correct relative positions be disturbed. Electrical interlocking must be provided between the two conveyors, therefore, to safeguard this synchronization. However, there must also be an electrical interlock between the auxiliary conveyor and its associated hopper, so that should the latter become empty, or fail to supply workpieces for any reason, the auxiliary conveyor drive will stop. In this event, the main conveyor will stop also, and this stoppage may afford the first evidence that a failure has occurred. Without an automatic sensing system, tracing of the fault to the hopper mechanism of an auxiliary conveyor might take a considerable time, and during this period the complete plant might well be at a stand-still.

SPECIAL SWITCHES

Other automatic sensing equipment includes switches which operate as the result of excessive noise, such as that caused by a worn bearing, or vibration, and this type of switch provides a very early indication of potential failure, so that the appropriate maintenance can be undertaken, before the break-down occurs. Switches are also available which operate in accordance with fluctuations in pressure, or temperature, and others which are responsive to the rate of flow of a liquid.

Finally, it should be noted that some operations in an automatic factory are carried out in a strict time sequence, and this sequence must not be disturbed in the event of a breakdown. In such a case, the maintenance engineers must be provided with information on the correct order of re-starting various items of equipment, after maintenance.

For a large automatic plant, the cost of the wire employed to connect the numerous detection points to the control console may well represent a considerable part of the outlay involved, and, in order to reduce this cost to a minimum, all control units are arranged to operate on low voltage, single-phase, current supply.

PRODUCTION OF ELECTRIC IRONS in the United Kingdom during the first, second and third quarters of last year was 326,000, 504,000 and 693,000 respectively, and during these periods, 138,000, 159,000 and 162,000 respectively were exported. For comparison, the corresponding figures for output during the first, second and third quarters of 1956 were 540,000, 567,000 and 615,000, and for exports, 198,000, 174,000 and 147,000.

News of the Industry

Sheffield

HEAVY DEMAND FOR STEEL.—The output of steel ingots and castings is fully maintained in this area, and the call for special steels, and particularly stainless and rustless qualities, continues at a high level. Magnet steels are also in strong request from the electrical and wireless industries. Increased supplies of springs, axles, crankshafts and engine parts are being absorbed by the motor car and motor vehicle manufacturers. Many local firms will benefit from orders placed by the British Transport Commission for various railway products. A good business is reported in steel forgings and turbine shafts, and hollow-forged boiler drums are being ordered by the makers of oil and petrol refining plants. Shipbuilders' steel requirements continue to provide good employment at various works.

Heavy engineering firms, including the makers of steelworks plant, have good order books on both home and export account. In the lighter engineering trades and among tool manufacturers order books are well filled, and machine knives and twist drills are in brisk demand. The seasonal trade in agricultural and horticultural steels and implements is developing steadily. Good supplies of pig-iron and scrap materials are available in this district.

ENGLISH STEEL CASTINGS CORPORATION, LTD., have received an order for 278 4-wheel, Commonwealth-type, one-piece cast-steel bogie frames. These castings are required in connection with a contract which is being executed by Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester, for the South African Railways. The overall length of the frames will be 18 ft. 6 in., and they will weigh approximately three tons each. The bogies will be fitted to 3,000-volt electric locomotives to be built by Metropolitan-Vickers-Beyer, Peacock, Ltd., Stockton-on-Tees. The bogie frames will be despatched at the rate of twelve per month, starting in October, 1958. The first of the diesel electric locomotives fitted with Commonwealth bogies, and built by Brush Traction, Ltd., Loughborough, went into service on British Railways at the end of last year.

SNOW & CO., LTD., report no diminution in the big demand for surface-grinding machines, and orders are in hand on both home and export account for small, medium and large-capacity machines of various types. In the works we noted both horizontal and vertical spindle machines in progress, also openside and double-column plano-type slideway grinding machines, and double-disc surface grinders.

F. M. PARKIN (SHEFFIELD), LTD., have now completed their various extensions, which have been in progress for some time. These extensions provide additional steel bays, a single-storey tool factory, and a re-designed 2-storey building to accommodate the commercial offices on the upper floor and a laboratory on the ground floor, both of which have been considerably extended. The extensions, together with much additional equipment, were necessary to meet the growing home and Continental demand for all grades of high-speed steels in the form of bars and blanks, die and chisel steels, and butt-welded tap blanks, also lathe and planer tools, high speed steel tool bits, ground flat stock and special form tools. Our attention was drawn to the latest addition to the firm's range of high speed steels, known as FMP Triple 5C. This has been developed for use on Nimonic alloys, special steels and other high-tensile materials, and is said to have exceptional resistance to abrasion. Centreless bar grinding and heat treatment for the trade are undertaken at these works.

New warehouses and offices have recently been opened by the firm at 6-9 Red Lion Market, Whitecross Street, Finsbury, London, and at Chapel Street, Booth Street, Handsworth, Birmingham. Towards the end of last year the company acquired the whole of the share capital of Trutone Products, Ltd., repetition machinists, Eyre Street, Sheffield.

DAVY AND UNITED ENGINEERING CO., LTD., are nearing the completion of the transfer of their plant from one side of the city to the other. For more than 20 years these makers of rolling mills and forging presses have been gradually moving the business from premises now acquired by the English Steel Corporation, Ltd., to the site at Darnall. The smith's shop and the administrative staff are the last sections to be transferred.

FLAME-HARDENERS, LTD., are as busy as ever in meeting the demand for heat-treatment of rolls, rams, roller bearing faces, oil well drilling equipment, spur and bevel gears, tractor sprockets, and road-making machinery and excavator components. Work in hand which is destined for South African

Railways includes the hardening of slide bars, pistons, reversing links and other components. Our attention was drawn to the recently-completed extensions comprising a lofty building, equipped with a 20-ton overhead electric travelling crane, a tall vertical oil tank, and a Redifon 125 kVA. electric induction furnace, where fully-automatic induction hardening is to be carried out.

David Brown Industries, Ltd., Foundries Division, Penistone, in order to provide facilities for the acid pickling of steel castings of various types and weights, have recently designed and installed tanks as shown in the accompanying illustration. The largest castings at present requiring treatment are half turbine casings, weighing up to 8 tons, for which orders are in hand for conventional and atomic power stations.

Two identical tanks have been built, together with a neutralizing sump. A two-way reversible pump serves both tanks and complete transfer of the liquid can be effected in 5 min. After lowering the casting into the empty tank, the slinging chains are removed, and acid is then transferred from the other tank. By means of heating elements, the acid solution is kept at a temperature of about 60 deg. C.

While pickling is in progress, the second tank is loaded, so that almost continuous processing is obtained.

H. B.

Acid Pickling Tanks at the Penistone Works of David Brown Industries, Ltd.

East Midlands

Angular Hole Drilling & Manufacturing Co., Ltd., Beeston, Nottingham, are as busy as ever with the manufacture of their very wide range of spanners and wrenches, some of which are produced on special machines developed by the company over a period of many years. Box spanners are machined from solid bar, except in the case of some large sizes, which are produced from forgings. Hexagon and square sockets in these tools are produced by the angular drilling process which was developed towards the end of the last century. The geometrical forms thus produced are accurately shaped, and, it is claimed, resist deformation over long periods of service.

This company also makes box spanners and ring wrenches of exceptional size, and in this connection it may be noted that an order was executed for a 4¾-in. B.S.F. octagonal spanner with a measurement across the flats of 6⅞ in. The spanner, which weighed 175 lb. when fully machined, was produced from a 256-lb. forging. In addition to the normal range of spanners, the company can supply face spanners of various types, pin spanners, ratchet spanners, adjustable ratchet pin keys, lathe handles, and tools of special design to customers' drawings.

The Sandiacre Screw Co., Ltd., Sandiacre, Nr. Nottingham, was established in 1877 and has specialized, since 1936, in the production of stainless steel nuts, bolts, and screws turned from bar. The machine shop now occupies three large bays where Ward and Herbert capstan lathes, and Browne & Sharpe single-spindle and Wickman multi-spindle automatics are installed, together with other specialized production equipment, which includes several B.S.A.-Huller tapping machines, provided with indexing fixtures. During the process of expansion, the premises have been extended to provide a new store, administrative offices and a modern canteen for the employees.

Large stocks of stainless steel, covering the majority of known grades, are always maintained, so that work can be produced to most specifications without delay in obtaining material. The shops are equipped and planned for the efficient production of parts in numbers from, say, 100,000 to very small batches and even single items, and many of the orders executed involve only short runs. The demand for stainless steel threaded components continues to increase, largely from the chemical, dyeing, brewing, food-processing and similar industries. Bolts are made in all sizes from 1½-in. B.S.W. hexagon head, down to 6 B.A. Threads produced include all those in general use, in both right- and left-hand forms.

UNIVERSAL ENGINEERING Co., Castle Boulevard, Nottingham, report that the level of business is well maintained in all departments. This old-established firm is engaged in the large scale production of non-ferrous castings, many of which are in light alloy and brass. Pressure and gravity die castings are also made here for many industries.

HERBERT WIDDOWSON & SONS, LTD., Canal Street, Works, Nottingham, inform us that they are shortly to introduce a new service to provide for the complete rebuilding of Cincinnati milling machines, and that additional plant has been installed in the shops, to provide the extra machining facilities that will be needed. P.B.R. horizontal boring and facing machines, which can be supplied with horizontal and vertical milling attachments, are reported to be selling well in this country.

JOHNSON BROS. (TAPS & DIES), LTD., Charles Avenue, Chilwell, Nottingham, have recently increased their capacity for the production of taps and dies which are supplied largely for use on high-speed automatics and nut-tapping machines. In the heat-treatment bay, additional modern equipment has been provided, which enables the various hardening and tempering processes to be accurately controlled. Thread grinding is carried out on a considerable scale, and the equipment installed for this purpose includes, Coventry Gauge & Tool Co., Lindner, Reishauer and Excello machines. Lathes by Bryant Symons are employed, also special-purpose machines developed by Johnson Bros.

This company has developed a special technique for the manufacture of very small taps as used in the instrument industry. The machines employed for this purpose will produce taps for threading holes down to 0·010 in. diameter.

DECO MACHINERY, LTD., Percy Road, Leicester, inform us that a 3,500-sq. ft. extension to their works is now being built to permit replanning and expansion of their production facilities. Various new machine tools are on order, including four Ward No. 7 combination turret lathes, three 2A and three 3A machines by the same maker, and a Midgley and Sutcliffe 4-ft. radial drill. It is anticipated that the reorganization will be complete and that full production will have started by May. The company report that enquiries and sales of their wire flattening and spooling machinery for both home and export are well maintained. The Deco spooling machines are hydraulically-powered units which are made in a range of sizes for coiling wire or flat tapes on cores from 2½ to 34 in. diameter, with an 8-in. spool width. Flange diameters range up to 48 in., and spool shaft operating speeds from 50 to 300 r.p.m. The wire flattening mill is a 10-h.p. worm driven unit, with 4-in. wide by 6-in. diameter rolls. Rolling speeds up to 350 ft. per min. are obtainable. The company is also receiving a steady flow of orders for sub-contract machining, and the production of sub-assemblies for various trades.

F. W. H.

The Machine Tool Industry

For the purpose of correcting any misconceptions which may exist, among those not intimately concerned with metal working, as regards the nature and functions of the machine tool industry, a statement has been issued by the Machine Tool Trades Association, in the form of a 12-page booklet, which is being widely circulated. By reason of the fundamental importance of this industry, which is out of all proportion to its size, it is to be hoped that this booklet will be studied with the attention that it deserves, in order that it may fulfil its purpose of placing "the functioning and importance of machine tool engineering in its true industrial perspective."

Sections are included under the headings: what are machine tools?; size of the industry; location; structure of the industry, development, export and import policy; and scope for skill.

As an indication of the growth of the industry in recent years, it is pointed out that production in 1954 was valued at £66 million, in 1955 at £75½ million, in 1956 at £85½ million, and in the first half of 1957 at £48½ million.

It is also indicated that in 1948 the capital employed by 115 representative machine tool building firms was £25·5 million, whereas by the end of 1957 the total for these same firms was £78·5 million, and it is estimated that by 1963 the figure will be about £93 million. During the period from 1948 to the end of 1957, moreover,

these companies added 4·7 million sq. ft. of new buildings or extensions to their works, representing an expenditure of £8·8 million, and anticipate that by the end of 1960 a further 2 million sq. ft. will have been added at a cost of about £5·2 million. Similarly, new machinery, plant, and equipment to the extent of 28,857 tons (£21·4 million) were installed, and it is estimated that this quantity will have been augmented by a further 10,800 tons (£9·6 million) by 1960.

Elliott Machine Tool Exhibition

A full range of machine tools and production equipment made by member companies of the B. Elliott Group was exhibited recently by the parent firm, B. Elliott & Co., Ltd., Victoria Works, Willesden, London, N.W.10, at Bingley Hall, Birmingham.

Among the exhibits, all of which were available for demonstration, were noted Victoria horizontal, universal and vertical milling machines, also the Victomatic production and Omnimil types; Cardiff centre lathes; Invicta and Alba shapers; Progress drilling machines; Velox hacksawing machines; Excel surface and tool and cutter grinders; Speedax bandsawing machines; and Melford floor grinders.

A new product, which was on view, is the Progress No. 16, ½-in. capacity drilling machine for bench mounting. Drive from the ½-h.p. motor is transmitted by a V-belt and stepped pulleys, which give four spindle speeds ranging from 460 to 2,900 r.p.m. A sheet metal belt guard, and with it the driving motor, can be tilted, after releasing a latch, to facilitate changing the spindle speeds. The spindle has a travel of 3⅞ in., and a maximum distance of 15 in. is obtainable between the chuck and the 9- by 11¾-in. base. An adjustable stop is fitted to facilitate drilling holes to pre-determined depths. If required, a 9- by 11¾-in. work table, which can be swivelled on the 2½-in. diameter column, and tilted on each side of the horizontal position, can be provided.

The Invicta Major 30-in. stroke shaping machine was shown fitted with a prototype universal table of new design, which can be swivelled through 360 deg. about a horizontal axis, by worm gearing. A substantial casting of approximately semi-circular shape in cross section, which forms part of the table and incorporates the T-slotted working surface, can be tilted through angles up to 15 deg. in each direction, by a pinion and segment gear. The gearing for tilting and swivelling the table is operated by a detachable capstan-type handwheel.

Elgar Midlands Showrooms

A wide range of machine tools was recently exhibited in the new Midlands showrooms of the Elgar Machine Tool Co., Ltd., whose head office is 172 Victoria Road, London, W.3. These new showrooms, which have an area of 3,600 sq. ft., are situated at 1075 Kingsbury Road, Birmingham, 24. Space for expansion is available on the site, and it is planned to enlarge the showrooms, at a later date, to accommodate an increasing variety of machine tools. Provision is made for running all the machine tools under power, and qualified demonstrators are available at all times. As the company's range of products increases, examples of newer equipment will be displayed in the showrooms for demonstration and sale.

View of Part of the New Showrooms of the Elgar Machine Tool Co., Ltd., at Castle Bromwich, Birmingham, 24

The Need for Engineering Apprentices

(*Continued from page* 467)

providing more pre-apprenticeship courses at technical colleges.

Given the will on the part of the employer to train apprentices, it is not sufficient merely to attract candidates. There must be provision for systematic selection to ensure, as far as possible, that those chosen possess the necessary intelligence and aptitude. Methods of training should also receive careful consideration to enable the quality of instruction to be improved, and, where possible, the period shortened.

A short section of the report is concerned with opportunities for girls, and the sub-committee note that whereas most apprenticeships are open to them, the number of girls who serve craft apprenticeship is very small. They go on to express the hope that "employers will not discourage suitable girls who wish to be trained under apprenticeship or similar arrangements purely because it has been traditional to train boys." It may be recalled that the advantages that would result if more women were trained as qualified engineers and technologists were discussed in a recent issue of MACHINERY. Much the same arguments apply to training for skilled metal working, and in view of the remarkable dexterity and sense of touch that many women factory workers acquire, there is no doubt that with adequate instruction they would be well qualified to undertake tool-making work of the highest standards. Women might also be employed with advantage for maintenance work on light intricate mechanisms which will necessarily be incorporated to an increasing extent in various types of factory equipment as the degree of automation is intensified.

Clearly there are many problems to be solved if the intake of apprentices in various sections of the metal working industries is to be substantially and rapidly increased. With a vigorous approach, and with co-operation between engineering manufacturers, and between those manufacturers and technical education authorities, however, these difficulties should be overcome, bearing in mind that the opportunity is for a limited period, and will not occur again in the foreseeable future.

OUTPUT OF AIRCRAFT in the U.K. (excluding military types, other than those for export) rose from 388 in 1954, to 555 in 1955, and to 673 in 1956. During October and November, respectively, of the latter year, 77 and 76 aircraft were produced, and 40 and 52 during the corresponding months of 1957.

Report on Apprentice Training

In each year since the second world war, about 640,000 boys and girls have reached the age at which they are legally free to leave school. In 1958 this number will increase to 712,000, and in 1962 to 929,000, which is some 50 per cent higher than the figure for the year 1956. As far as can be foreseen, the numbers will decrease rapidly from 1963, and by 1965 will have stabilized at the rate of about 740,000 school leavers each year. Fortunately, this increase in the number of young people available for employment will coincide with a growing need for an adequate supply of trained workers in industry.

To consider the arrangements for their training, with particular reference to the adequacy of intake into craft apprenticeship, a sub-committee under the chairmanship of Mr. Robert Carr, Parliamentary Secretary to the Ministry of Labour and National Service, was appointed, in the spring of 1956, by the National Joint Advisory Council, and was made up of representatives of the British Employers' Confederation, The General Council of the Trades Union Congress, and the nationalized industries. The report of the committee,* which is entitled "Training for Skill," has now been published.

In an introductory chapter, it is pointed out that the increased numbers of young people entering industry will do no more than to reduce the decline in the relative size of the country's labour force as compared with the total population, and for the nation as a whole, the problem is not one of employment. Rather, it is how to ensure that facilities for training are available for greater numbers. There is a particular need for an increase in craft apprenticeships at a time when existing facilities are inadequate in quantity, and in some instances, also in quality. Failure to take full advantage of the opportunity that will be presented can have serious long-term consequences, because, "we cannot have skilled workers tomorrow unless we are prepared to train them today." The efforts of the Government should be directed to the expansion and improvement of arrangements for technical education, but responsibility for the industrial training of apprentices must rest firmly with industry.

It is recommended in the report that industries should lose no time in examining their craft apprenticeship requirements, and should then decide how the necessary training facilities are to be provided. In this connection, suggestions are made as to the means which might be adopted by small and large firms, and it is advocated that

* H.M. Stationery Office. Price 2s. 6d. net.

a National Apprenticeship Council should be established for the purpose of keeping training arrangements in general under review. Firms should release apprentices for day-time study at technical colleges, and care should be taken to allocate individuals to courses within their educational capacities. Training for non-apprentices should be developed, particularly in industries that employ a high proportion of semi-skilled workers. A section of the report is devoted to recommendations for the training of young women, and reference is made to the recently-introduced commercial apprenticeship scheme for both sexes.

Personal

Mr. A. W. Kirton has been appointed technical representative in the South West area for British MonoRail, Ltd., Wren Works, Chadderton, Lancs.

Mr. S. G. Medcraft, formerly London sales representative of Fielding & Platt, Ltd., Gloucester, has now been appointed sales manager for the company.

Dr. John Douce of Manchester University has been retained by Servomex Controls, Ltd., Crowborough, Sussex, as consultant to advise on theoretical problems arising in the field of non-linear control systems, and systems subject to random fluctuations.

Mr. Charles Pullan, a director of Armstrong Whitworth (Metal Industries), Ltd., Gateshead-on-Tyne, was recently appointed chairman of the Roll Makers' Association of Great Britain.

Mr. F. N. Noel Pike of 27 Hill View, Henleaze, Bristol (telephone number Bristol 62-5420), has been appointed representative for F. M. Parkin (Sheffield), Ltd., St. Thomas Steel Works, Sheffield, 8, for the South West of England and South Wales.

Mr. W. E. Knox, C.M.G., director of the Administration Division of the Export Credits Guarantee Department, 59-67 Gresham Street, London, E.C.2, has retired. He has been succeeded by Mr. F. H. Whitaker, O.B.E., who was formerly in the Industries and Manufactures Department of the Board of Trade.

Col. Anthony R. B. Dobson, managing director of Dobson & Barlow, Ltd., Bolton, was recently elected president of the Bolton and District Engineering Employers' Association. He follows his father and grandfather in the position. Col. Dobson is also vice-president of the Bolton Chamber of Commerce.

Mr. Charles Lashly, commercial manager of Armstrong Whitworth (Metal Industries), Ltd., Gateshead-on-Tyne, has been appointed London office manager of the company and of Jarrow Metal Industries, Ltd., at 6 St. Albans Street, London, S.W.1. His place at Gateshead has been taken over by the former assistant commercial manager, Mr. Frank Robinson.

Mr. G. L. Brownson, B.Sc.Tech., M.I.E.E., who has been works manager of Small Electric Motors, Ltd., Eagle Works, Churchfields Road, Beckenham, Kent, for 18 years, has been appointed technical director and chief engineer. Mr. K. H. Harding, who has been with the company for 11 years as sales manager, has been appointed sales director. Mr. J. A. Wilson, B.Sc.Tech.(Hons.), A.M.I.E.E., who has been assistant works manager for the past 17 years, has been appointed works manager.

New I.Prod.E. Awards

At a meeting of the Council of the Institution of Production Engineers, held recently, it was announced that the long and distinguished service rendered to the Institution over many years by three prominent members was to be recognized by the establishment of an additional named paper and two annual awards.

The members so honoured, each of whom has held the office of President of the Institution, are: Mr. E. W. Hancock, O.B.E. (director and general manager, Humber, Ltd.); Sir Walter Puckey (director, The British Tabulating Machine Co., Ltd., Everett, Edgcumbe, Ltd., Black & Decker, Ltd., and other companies); and Mr. J. D. Scaife (consulting engineer). The named paper and annual awards are as follows: *The E. W. Hancock Paper*—to be presented on the subject of "Human Relations in Industry." *The Sir Walter Puckey Prize*—to be an annual prize of £50 in cash, awarded to a student (not necessarily a member of the Institution) showing outstanding performance in the Dip. Tech. or Post Dip. Tech. as applied to production engineering. *The J. D. Scaife Award*—to take the form of a medal awarded for the best paper published in the *Institution of Production Engineers Journal*, each year, with the exception of named papers.

The first E. W. Hancock Paper will be presented during the Production Conference at Olympia from May 12 to 21.

Obituary

Mr. W. Bernard Challen.—We regret to record the death of Mr. W. Bernard Challen, chairman and managing director of Taylor & Challen, Ltd., at his home in Birmingham on February 12. Born in 1866, he followed his father in the business in which he spent all his working life, apart from one short interval. He became a director on the conversion of the firm to a limited liability company in 1889, managing director in 1902, and also assumed the office of chairman on the death of his father in 1937. Under his guidance, the firm specialized in press manufacture, and design was always his chief interest.

His connection with the Institution of Mechanical Engineers went back to 1889, and he was chairman of the Midland Branch in 1929, 1931 and 1932. During this tenure of office he took a leading part in establishing the James Watt Memorial Institute as a meeting place for Birmingham Technical Societies, and was chairman of the Management Committee until 1955.

He retained his full mental powers to the end of his life, and was at work on the day before his death.

Industrial Notes

WILD-BARFIELD ELECTRIC FURNACES, LTD.—The address of the Midlands office of the company, from March 1, will be 71 Broad Street, Birmingham, 15 (telephone number, Midland 7232).

FOXBORO-YOXALL, LTD., inform us that they are now occupying their new offices at Redhill, Surrey (telephone number, Redhill 5000). Facilities have been expanded to meet both immediate demands and increases which are anticipated in the near future.

THE SECOND NATIONAL PACKAGING CONFERENCE will be held at the Grand Hotel, Eastbourne, from April 24 to 26. The theme of this conference will be "packaging and profit," and full particulars can be obtained from Mr. Maurice Paynter, F.C.C.S., The Institute of Packaging, 20-21 Took's Court, Cursitor Street, London, E.C.4.

JOSEPH L. THOMPSON & SONS, LTD., North Sands Shipbuilding Yard, Sunderland, are to install plant at their shipyard for removing scale from oil tankers by shot blasting. This plant will cost between £30,000 and £40,000. The normal method of removing the scale is by the use of wire brushes, or chipping.

TECALEMIT, LTD., Plymouth, Devon, have extended their range of air compressors by the introduction of three smaller sizes with piston displacements of 2.7, 5 and 6.5 cu. ft. per min. Suitable for filling stations or garages, these compressors can also be employed to supplement existing supplies, or for stand-by purposes in connection with larger units.

THE SEVENTH INTERNATIONAL MECHANICAL ENGINEERING CONGRESS, organized by Vereniging van Metaal-Industrieën, will be held at The Hague from June 2 to 6. Copies of the provisional programme and forms of application can be obtained from The Secretariat of C.I.M.7, 14 Burgemeester de Monchyplein, The Hague, The Netherlands. Applications must be submitted before March 15.

HOOVER, LTD., Perivale, Middlesex, report that the accident severity and frequency rates last year in the Hoover factories in England, Scotland, and Wales were the lowest yet recorded. The number of hours lost through accidents per 100,000 hours worked was 77.49, or 54 per cent less than in 1956. The number of lost time accidents per 100,000 hours worked was 0.53 which represented a reduction of 39 per cent as compared with the 1956 figure.

ASLIB, 4 Palace Gate, London, W.8, have issued Vol. V of their Index to Theses accepted for higher degrees in the universities of Great Britain and Ireland. This volume, edited by Magda Whitrow, B.A., A.L.A., covers the period 1954-55. It is pointed out that theses literature is a valuable source of information for research workers and technologists that has been virtually untapped in the past. (The price per volume is 25s.—21s. to members of Aslib.)

HERBERT MORRIS LTD., Loughborough, and BROWN LENOX & CO. (LONDON), LTD., West Ferry Road, London, E.14, are forming a joint company which will begin operations at Millwall, London, E.14, on April 1, and will continue the work of the existing Lifting Gear Department of Brown Lenox. At the same time, it will take over the spares and servicing organization for Morris equipment in the area.

BROWNING STREET INDUSTRIES, LTD., Browning Street, Birmingham, 16, have recently opened a showroom at their factory where the products of the following subsidiaries are shown: W. T. French & Son, Carpenter & Allen, G. & W. Purser, and Ladbrook Stampings. These products include horticultural and agricultural spraying equipment, hose fittings, drop stampings, and pressed and spun parts for the general engineering industry.

THE SOCIETY OF MOTOR MANUFACTURERS & TRADERS, LTD., will be required to relinquish their tenancy of 148 Piccadilly in connection with the road planning scheme for Hyde Park Corner. For their new headquarters the Society have purchased Forbes House on a 99-year lease. These premises stand on a site of nearly one acre, with frontages on Halkin Street and Grosvenor Crescent.

THE INSTITUTION OF ENGINEERING DESIGNERS, 38 Portland Place, London, W.1, inform us that their Midland Branch is holding a film show at the Queens Hotel, Birmingham, on March 5 at 7.45 p.m. The following films, provided by A. A. Jones & Shipman, Ltd., will be shown: "To be Precise," "Cutter and Tool Grinding," "Surface Grinding," and "Cylindrical Grinding." Non-members are welcome to attend.

DURHAM RAW MATERIALS, LTD., 1-4 Great Tower Street, London, E.C.3, inform us that as a result of increased output in the U.S.A., more plentiful supplies of Hypalon synthetic rubber will be available in this country. Industrial applications include conveyor belts for hot materials, and, recently, rollers which must be resistant to heat and chemicals. These rollers, it is stated, are now being tried out for a variety of purposes involving temperatures from 200 to 400 deg. F., and loads up to 500 lb. per linear inch.

£40,000,000 POWER STATION PROJECT.—Work is to begin this year on the largest power station yet built in this country, at Thorpe Marsh, near Doncaster, which, it is estimated, will cost £40,000,000. It is understood that the Central Electricity Authority proposes to place an order for a 550,000 kW. boiler for this station, which would be the largest single unit in the world. When completed the station will supply 1,200 megawatts to the National Grid.

MOTOR VEHICLE PRODUCTION AND EXPORTS.—In January the production of motor vehicles (cars, goods vehicles, and buses) totalled 111,330. Exports of cars and commercial vehicles numbered 59,421, the highest monthly figure yet recorded. Of this total, cars accounted for 45,762, including 14,000 consigned to the U.S.A. The aggregate value of exports of the vehicle industries (comprising cars, commercial vehicles, agricultural tractors, and equipment) in January was £43¼ million.

BRITISH HOIST & CRANE CO., LTD., Compton, Berkshire, have introduced a long-stuff (carrying) attachment for use with their Iron Fairy hydraulic mobile crane. This attachment enables such items as timber poles, cast iron piles, concrete piles, lamp standards, and steel sections to be readily transported. It takes the form of a steel platform extending along the crane on the side opposite the driver, which will accommodate loads up to 20 ft. long by 2 ft. wide by 3 ft. deep. The load is picked up by the crane, slewed round, and deposited on the platform.

SHANDON SCIENTIFIC CO., LTD., 6 Cromwell Place, London, S.W.7, have supplied us with particulars of the Shandon Glowring smoke density indicator which was developed by the Fuel Research Station of the Department of Scientific and Industrial Research. It consists of a special glowing element (the Glowring) which is placed in the side flue. This element is viewed through a column of flue gas from an observation window in the front wall of the flue. The brightness of the Glowring can be adjusted so that it is obscured when the smoke reaches a certain density.

INSTITUTE OF METAL FINISHING, 32 Great Ormond Street, London, W.C.1. The annual conference of the Institute will be held this year at the Palace Hotel, Torquay, from April 15 to 19, and full particulars may be obtained from The Conference Secretary at the above address. Subjects of individual papers will include: Electrodeposited composite coatings; Comparisons between different nickel plating processes; Bright nickel and levelling power; Stress in nickel electrodeposits; Methods of testing anodic coatings on aluminium; Some aspects of the growth of electrodeposits; the Measurement of colour; and Selection of coloured pigments for industrial finishes.

SUPPLEMENTS TO BOOK OF ASTM STANDARDS.—The American Society for Testing Materials, 1916 Race Street, Philadelphia, 3, Pa., U.S.A., has now issued the 1957 Supplements to the Book of ASTM Standards. This book is published triennially, and is kept up to date by supplements for the intervening years. The 1957 Supplements, issued in seven parts, give, in their latest forms, 415 specifications, tests, and definitions, which either were issued for the first time in 1957, or have been revised since they appeared in the 1955 Book or the 1956 Supplements. These parts, which are published at the price of 4 dollars each, or 28 dollars for the set, are concerned with: ferrous metals; non-ferrous metals; cement, concrete, ceramics, thermal insulation, etc.; paint, wood, cellulose, sandwich and building constructions, fire tests, etc.; fuels, petroleum, aromatic hydrocarbons, etc.; rubber, plastics and electrical insulation; and textiles, soap, paper, adhesives, shipping containers, etc.

The Production Exhibition

The third in the series of Production Exhibitions, sponsored by the Institution of Production Engineers, will be held at Olympia, London, from May 12 to 21, and its theme will be "Production Fights Inflation." The opening ceremony will be performed by the Rt. Hon. The Lord Mills, Minister of Power.

A conference will be held concurrently with the exhibition, and at the first session a paper entitled "Selling in World Markets" will be presented. The titles of papers which will be given at succeeding sessions are as follows: The Economic Background (Professor F. W. Paish, London School of Economics and Political Science); Cybernetics (Dr. F. H. George, Department of Psychology, University of Bristol); Operational Research Case Studies (Mr. J. Harling, Orbit (Operational Research), Ltd.); Designing Machines for Electronic Control (Dr. F. Koenigsberger, Reader in Machine Tools and Production Processes, University of Manchester); and Automatic Equipment for Jobbing Work (Mr. I. H. Nickols, Nickols Automatics, Ltd.). At the final session of the conference the first E. W. Hancock Paper entitled "Human Relations in Industry" will be presented by Mr. L. Wright, chairman, British Productivity Council.

Exhibition of Gauging Equipment

Thomas Mercer, Ltd., Eywood Road, St. Albans, Herts., are holding an exhibition and demonstration of dial gauging and air gauging equipment at the premises of their Scottish agent, J. F. Tennent, 52 St. Enoch Square, Glasgow, C.1, from March 3-8. The exhibition will be open from 9.30 a.m. to 6.0 p.m. each day. Included among the exhibits will be a ten-column liquid unit for checking ten dimensions simultaneously, a high-magnification air gauge unit, a recorder air gauge unit, and other standard air gauging and dial gauging equipment.

Machine Tool Exports and Imports

EXPORTS OF MACHINE TOOLS

Type of Machine	Month ended December 31, 1957	Year ended December 31	
		1956	1957
	Value £	Value £	Value £
New, complete—			
Boring machines:			
Vertical	28,368	463,291	483,500
Other	49,424	567,748	850,129
Drilling machines	161,468	1,843,480	2,068,443
Grinding (excluding thread grinding) lapping and honing machines	222,245	2,469,989	2,772,683
Lathes:			
Automatic	106,977	1,927,959	2,133,871
Capstan	130,169	2,299,662	2,567,582
Other	244,844	2,793,046	3,368,966
Screwing machines	33,355	172,916	227,979
Threading machines	20,171	411,525	556,373
Milling machines (excluding thread-milling) and gear cutting machines	228,064	1,998,501	2,504,111
Planing, shaping and slotting machines	73,738	782,073	792,099
Presses:			
Hydraulic	42,113	1,866,275	1,386,165
Other	204,954	664,274	1,297,854
Punching and shearing machines	38,651	263,957	442,444
Other plate and sheet metal-working machines including straightening rolls	8,974	254,162	363,328
All other machines	221,592	2,199,831	3,029,237
Used machines, complete	48,909	1,120,145	775,623
Parts	199,503	1,789,591	2,471,508
Total	2,063,519	23,888,425	28,091,895
Destination			
Union of South Africa	141,687	1,300,428	1,645,337
India	191,572	2,649,506	3,389,535
Pakistan	27,195	272,509	202,086
Australia	412,582	3,798,832	4,130,935
New Zealand	33,879	398,061	403,554
Canada	108,091	2,160,016	2,210,242
Other Commonwealth countries	116,404	1,396,998	1,395,530
Soviet Union	—	830,038	1,012,708
Sweden	49,286	1,022,559	803,881
Netherlands	43,637	790,944	764,993
France	123,087	1,876,136	2,124,607
Spain	135,511	991,959	1,450,816
Italy	65,985	515,929	876,241
U.S. America	234,927	1,554,440	2,733,888
Other foreign countries	379,676	4,330,070	4,947,542

IMPORTS OF MACHINE TOOLS

Type of Machine	Month ended December 31, 1957	1956	1957
New, complete—			
Boring and broaching machines	163,269	2,265,154	2,416,035
Drilling machines	23,366	346,548	412,063
Gear-cutting machines	13,243	1,105,405	900,085
Grinding, lapping and honing machines	150,846	3,124,001	2,238,785
Lathes:			
Automatic	141,787	2,793,623	2,379,259
Other	39,741	451,741	280,655
Milling machines	213,056	3,418,425	2,667,829
Planing, shaping and slotting machines	18,099	456,247	324,886
Presses	76,464	1,172,347	1,019,907
All other machines	351,512	6,262,091	4,948,640
Used machines, complete	21,208	802,975	341,986
Parts	248,504	3,447,699	3,841,810
Total	1,461,095	25,646,256	21,771,940
Country of Origin			
Western Germany	467,525	8,559,572	8,441,299
Switzerland	243,788	2,793,143	2,826,418
U.S. America	512,796	10,495,472	7,177,679
Other foreign countries	236,986	3,798,069	3,326,544

Coming Events

INSTITUTION OF MECHANICAL ENGINEERS.—*Scottish Branch.* March 6, at 7.30 p.m., at the Royal College of Science and Technology, Glasgow; and March 7, at 6.30 p.m., at the North British Hotel, Edinburgh; paper on "A Review of Applications of Radioisotopes to Engineering," by J. L. Putman. *Yorkshire Branch.* March 5, at 6.30 p.m., at the Grand Hotel, Sheffield; paper on "The Economics of Plant Renewal and Replacement," by C. W. Griffiths. *North Eastern Graduates' Section.* March 5, at 7 p.m., in the Lecture Theatre, Rutherford Technical College, Northumberland Road, Newcastle-upon-Tyne; paper on "Photography in Industry," by A. Horder.

INSTITUTION OF ENGINEERING INSPECTION.—*Coventry and District Branch.* March 4, at 7.30 p.m., at the Technical College, Coventry; paper on "Production and Inspection of Dunlop Disc Brakes," by J. H. Darling.

INSTITUTE OF METAL FINISHING.—*North-West Branch.* March 6, at 7.30 p.m., at the Engineers' Club, Albert Square, Manchester; paper on "Chemical Polishing of Metals," by F. H. Wells.

INCORPORATED PLANT ENGINEERS.—*Peterborough Branch.* March 4, at 7.30 p.m., at the White Lion Hotel, Church Street, Peterborough; paper on "Electronic Control of Machine Tools," by N. Milne.

INSTITUTION OF ELECTRICAL ENGINEERS.—*South-East Scotland Sub-centre.* March 4, at 7 p.m., at the Carlton Hotel, North Bridge, Edinburgh; and *South-west Scotland Sub-centre,* March 5, at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, Glasgow, C.2; paper on "The Digital Computer Applied to the Design of Large Power Transformers," by W. A. Sharpley and J. V. Oldfield, B.Sc. (Eng.).

INSTITUTION OF PRODUCTION ENGINEERS.—*Leeds Section.* March 10, at 7.30 p.m., at the Hotel Metropole, King Street, Leeds, 1; lecture on "The Design and Manufacture of Glass Forming Machinery," by C. A. Nichols. *Sheffield Section.* March 10, at 6.30 p.m., at the Grand Hotel, Sheffield; film on "Copy Turning," presented by Vaughan Associates, Ltd. *Edinburgh Section.* March 5, at 7.30 p.m., at the North British Hotel, Princes Street, Edinburgh; lecture on "The Case for Materials Handling," by F. H. Eccersley. An invitation is given to all interested in Materials Handling to attend this meeting. *Wolverhampton Section.* March 5, at 7.15 p.m., at the Wolverhampton College of Technology; lecture on "Computer Control of Machine Tools," by O. S. Puckle. *Reading Section.* March 6, at 8 p.m., at the Great Western Hotel, Reading; sound and colour film on "Copy Turning and Its Development," followed by a discussion with +GF+ representative.

Maxam Air Circuits

A well-presented publication issued by the Maxam Division of The Climax Rock Drill & Engineering Works, Ltd., Carn Brea, Redruth, Cornwall, gives particulars of 52 representative pneumatic circuits of varying degrees of complexity. Each circuit is shown by means of a clear diagram and the sequence of operations is concisely described on the facing page.

Trade Publications

PETER BRASSHOUSE, LTD., Spring Hill, Birmingham. Informative and well illustrated brochure concerned with the company's Drillmax automatic, screw feed, unit heads. Particulars of the various heads, which range from 1 to 15 h.p., are included, and numerous examples of special purpose machines, incorporating these heads, are shown. Diagrams indicate the various automatic operating cycles that can be obtained.

CHARLES CHURCHILL & CO., LTD., Coventry Road, South Yardley, Birmingham. Illustrated brochure in which the Vertimax range of production lathes is effectively described. The above company are distributors in this country for these lathes, which are made by Vertimax, Ltd., Glasgow, who also sell at home and abroad. There are two sizes, with maximum swing capacities under the tool slides of 21 and 24 in. diameter and standard motors of 10 and 25 h.p., also a modified machine of the larger capacity.

Machine Tool Share Market

Stock markets were generally unsettled in very quiet conditions during the past week, and, after fluctuating, most sections finished on a dull note, sentiment being affected by several adverse influences.

The gilt-edged section provided a firm exception. British Funds and kindred issues moved to slightly higher levels on moderate investment buying, but final prices were below the best.

Industrial markets were depressed for the most part, and share prices tended to fall. Although some resistance was shown to the downward drift, changes on balance were irregular, with declines predominating.

Among machine tool issues Edgar Allen lost 6d. at 28s.; Ambrose Shardlow, 6d. at 34s. 6d.; Thos. W. Ward, 6d. at 72s.; Asquith Machine Tool, 7½d. at 20s.; Butler Machine Tool, 3d. at 6s. 3d.; Kerry's (Gt. Britain), 3d. at 5s. 6d.; John Shaw & Sons (Wolverhampton), 3d. at 12s.; and Alfred Herbert, 1s. 3d. at 58s. 9d. On the other hand, British Oxygen advanced 1s. to 30s.

ASQUITH MACHINE TOOL CORPORATION, LTD. Final dividend 15 per cent, plus a bonus of 5 per cent, making, with the interim already paid, a total distribution of 30 per cent for the year ended September 30 last, as compared with 25 per cent for the preceding year.

BRITISH OXYGEN CO., LTD. Dividend 6 per cent, making, with the interim, a total distribution of 10 per cent (same).

COMPANY		Demon.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	9d.
Armstrong, Stevens & Son, Ltd.	Ord.	5/-	7/9
Allen (Edgar) & Co., Ltd.	Ord.	£1	28/-
" "	5% Prf.	£1	14/6*
Arnott & Harrison, Ltd.	Ord.	4/-	14/3
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	20/-
" " "	6% Cum. Prf.	£1	17/9
Birmingham Small Arms Co., Ltd.	Ord.	£1	25/-
" " "	5% Cum. "A" Prf.	£1	15/-
" " "	6% Cum. "B" Prf.	£1	17/6
" " "	4% 1st Mort. Deb.	Stk.	85/-
British Oxygen Co., Ltd.	Ord.	£1	30/-
" " "	6½% Cum. Prf.	£1	21/6
Brooke Tool Manufacturing Co., Ltd	Ord.	5/-	5/6
Broom & Wade, Ltd.	Ord.	5/-	9/9xd
" "	6% Cum. Prf.	£1	17/9
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	14/4½
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/6
Butler Machine Tool Co., Ltd.	Ord.	5/-	6/3
" " "	5% Cum. Prf.	£1	13/9
C.V.A. Jigs, Moulds & Tools, Ltd.	5½% Red. Cum. Prf.	£1	13/9
Churchill (Charles) & Co., Ltd.	Ord.	2/-	4/7½
" " "	6% Cum. Prf.	£1	26/3†
Churchill Machine Tool Co., Ltd.	Ord.	5/-	17/4½
" " "	6% Cum. Prf.	£1	18/9
Clarkson (Engrs.), Ltd.	Ord.	5/-	10/6
Cohen (George), Son & Co., Ltd.	Ord.	5/-	10/9
" " "	4½% Cum. Prf.	£1	14/3
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	14/6
" " "	5% Cum. Red. Prf.	£1	16/3
Coventry Machine Tool Works, Ltd.	Ord.	4/-	8/6
Craven Bros. (Manchester), Ltd.	Ord.	5/-	5/9
Elliott (B.) & Co., Ltd.	Ord.	1/-	3/-
" "	4½% Red. Cum. Prf.	£1	13/9
Export Tool & Case Hardening Co., Ltd.	Ord.	2/-	1/9
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	12/-
Greenwood & Batley, Ltd.	Ord.	£1	46/10½

COMPANY		Demon.	Middle Price
Harper (John) & Co., Ltd.	Ord.	5/-	14/-
" "	4½% Red. Cum. Prf.	£1	12/9
Herbert (Alfred), Ltd.	Ord.	£1	58/9
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	11/-
" " "	"B" Ord.	5/-	9/9
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	21/3
" " "	7% Cum. Prf.	5/-	5/-
Kayser, Ellison & Co., Ltd.	Ord.	£1	53/-
" " "	6% Cum. Prf.	£1	18/3
Kendall & Gent, Ltd.	Ord.	5/-	7/9
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	5/6
Kitchen & Wade, Ltd.	Ord.	4/-	10/6
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/4½
Massey, B. & S., Ltd.	Ord.	5/-	7/3
Modern Engineering Machine Tools, Ltd.	Ord.	5/-	11/-
Newall Engineering Co., Ltd.	Ord.	2/-	5/-
Newman Industries, Ltd.	Ord.	2/-	2/9
" "	6% Prf. Ord.	5/-	5/6
Noble & Lund, Ltd.	Ord.	2/-	4/9
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	16/3
" " "	5½% Cum. Prf.	£1	25/-
Pratt (F.) & Co., Ltd.	Ord.	5/-	20/-
Scottish MachineTool Corporation, Ltd.	Ord.	4/-	5/3
Shardlow (Ambrose & Co., Ltd.	Ord.	£1	34/6
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	12/-
Sheffield Twist Drill& Steel Co., Ltd	Ord.	4/-	35/-
" " " "	5% Cum. Prf.	£1	15/-
Stedall & Co., Ltd.	Ord.	5/-	4/9
Tap & Die Corporation, Ltd.	Ord.	5/-	7/9
" " "	4½% Deb. 1961-1977	Stk.	82/-
Wadkin, Ltd	Ord.	10/-	19/6
Ward (Thos. W.), Ltd.	Ord.	£1	72/-
" "	5% Cum. 1st Prf.	£1	15/6
" "	5% Cum. 2nd Prf.	£1	24/3
Willson Lathes, Ltd	Ord.	1/-	2/4½

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. † Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig-Iron

Foundry and Forge No. 3, Class 2

Middlesbrough zone	£21 6 0
Birmingham	£20 18 3

Phos. 0·1 to 0·75%

Birmingham	£23 17 0

Scottish Foundry

Grangemouth	£25 3 6

Hæmatite

English No. 1

N.E. and N.W. Coast	£25 6 6
Scotland	£25 13 0
Sheffield	£26 15 0
Birmingham	£27 4 0
Welsh	£25 6 6

Steel Products

Medium plates	£46 1 6
Mild steel plates, ordinary*	£42 12 0
Boiler plates*	£45 2 0
†Flat bars 5 in. wide and under / †Round bars under 3 in.	£40 8 0
Billets, rolling quality, soft U.T.	£33 1 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£235 0 0

Copper

Cash (mean)	£161 7 6
Cold rolled and hot rolled Sheets 4 ft. by 2 ft. by 10 SWG	£228 0 0—£228 5 0
Rods 3/16 in. to ½ in. diam.	£248 15 0
Tubes, 1½ in. bore by 10 SWG, ton lots, per lb.	2s. 4½d.
Wire rod, black, hot-rolled (¼-5/16 in.) English	£178 12 6

Zinc

Refined, minimum 98 per cent. purity, current month (mean)	£63 2 6

Brass

Tubes, solid drawn, per lb.	1s. 4½d.
Strip 63/37, 6 in. by 10 SWG coils, ton lots	£199 15 0—£202 5 0
Rods, ¼-3 in. diam. (59 per cent copper)	1s. 7½d.

Yellow Metal

Condenser plates, per ton	£137 0 0
Rods, per lb.	1s. 8½d.

Aluminium

Ingots min. 99·5 per cent Canadian d/d	£197 0 0

Lead

Refined, minimum 99·97 per cent purity, current month (mean)	£74 16 3

Tinplates

‡U.K. Home trade:	
Handmill f.o.t. makers' works	£3 12 2½
Cold reduced, f.o.t. makers' works	£3 7 10½
U.K. Export:	
Hot rolled basis, f.o.t. works' port	74s. 0d.—75s. 0d.
Cold reduced basis, f.o.t. works' port	76s. 0d.

Gunmetal

Ingots, 85.5.5.5. ex works	£152 0 0

*N.E. Coast, N. Joint Area, Central Scottish Zone.

†U.T. soft basic.

‡Official maximum price, after allowing for adjustments for increase in price of tin.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 0·7049 up to 2·21 and 2·41 a/f, ex works basis	£43 4 6
Free cutting black	£47 10 0

Reeled Steel Bars[1]

Single-reeled 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 17 6
Free cutting	£48 2 6

High-Speed Steel

Black random length bar. All prices basic, per lb., subject to extras.

Molybdenum "66"	5s. 10½d.
Molybdenum "46"	5s. 8½d.
14 per cent tungsten	5s. 9d.
16 per cent tungsten	6s. 1½d.
18 per cent tungsten	6s. 4d.
22 per cent tungsten	7s. 5d.
5 per cent cobalt	9s. 6d.
4·75/5·25 per cent molybdenum + 6·0/6·75 per cent tungsten + 1·75/2·05 per cent vanadium (5-6-2)	6s. 0½d.

Precision-ground, High-speed Free-turning Brass Rod[2]

⅝-in. dia. ± 0·00025-in. 2-ton lots, per lb.	2s. 2½d.

Grey Iron Rod

Die Cast[3] in random lengths 18 in. to 24 in. rough machined 1/16-in. above listed size. Extra for definite lengths, for hardenable alloy iron, and for orders of less than £50. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
¾ or ⅞ in.	255s. 6d.	318s. 10d.
1 or 1⅛ in.	204s. 4d.	251s. 10d.
1¼ to 1½ in.	143s. 0d.	171s. 2d.
1⅝ to 2 in.	106s. 2d.	125s. 11d.
2⅛ to 3½ in.	91s. 6d.	106s. 4d.
3⅝ to 12 in.	86s. 6d.	99s. 2d.

Continuous Cast

10-ft. lengths, centreless machined 1 to 3-in. dia. + 0·010 to 0·020 in., prices as quoted for die cast bar[3]

6-ft. lengths	¾ or ⅞ in.	245s. 4d.
centreless ground	1 or 1⅛ in.	196s. 4d.
+ 0·010 in. Extra		
for hardenable	1¼ to 1½ in.	137s. 10d.
alloy iron[4]	1⅝ to 2 in.	106s. 2d.
Per cwt. net.	2⅛ to 3 in.	91s. 6d.

Stellite[5]

Welding Rods (plain

¼ in. dia. per lb.	30s. 0d.

Toolbits

½ in. sq. × 4 in., each	22s. 3d.

Precision-ground Mild Steel[2]

1-in. dia. ± 0·00025-in. 4-ton lots, per cwt.	121s. 6d.

[1] Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. [2] Pratt, Levick & Co., Ltd., Chester. [3] Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. [4] "Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. [5] Deloro Stellite, Ltd., Highlands Road, Shirley, Solihull.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn:

(Usaspead) over 1½ to 2 in.	£59 17 6
Lead bearing (Usaled)	£63 17 6
Precision ground, 1½ in.	£81 12 6

Bright Drawn

M.S. bars (M.M.C.) over 1½ in. to 2 in.	£55 8 6
Square edge flats (Usaflat)	£72 5 0
M.S. angles (Usaspead)	£99 10 0
Casehardening (EN) (Usacase) over 1½ in. to 2 in.	£63 14 6
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£57 8 6
Carbon manganese semi-freecutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£71 14 0
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£65 2 6
0·4 Carbon Normalised (Usaspead "40") over 1½ in. to 2 in.	£67 4 6
Carbon manganese steel to Specification EN.16.T (Usaspead 5565), per ton	£127 10 3

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices less 5 per cent

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.) ⅛ in. to 2½ in., per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.) ⅛-in. to 2½-in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.) Genuine Stubs quality, per lb.	4s. 6d. less 27½%
M.M.C. quality, per lb.	2s. 5d. + 6¼%
Boxes of 16 assorted sizes 1/16-in. to ⅛-in. dia.	7s. 6d.

Stainless Steel

K.E. 40.AM (Freecutting), per lb.	3s. 3½d.

Glacier Machined Bronze Bars

Phosphor bronze (2B8) / Lead bronze	Prices on application

High-speed Steel

18 per cent. tungsten. Prices on application.

Toolholder bits:

Usaspead "Super" / ,, "Supreme" / ,, Cobalt 10	List price

Shimstock

Steel assorted, per tin	3s. 6d.
Brass ,, ,,	7s. 3d.

[6] Macready's Metal Co., Ltd., Pentonville Road, N.1. Subject to confirmation by London Office. Delivered free by van in London area.